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Relationship Between Size of Farm and Utilization of Machinery, Equipment and Labor on Nebraska Corn-Livestock Farms

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INTRODUCTION

PURPOSE OF STUDY

To understand the problems associated with size of farm two distinct kinds of analysis are needed. The first is represented by the study here reported, which is an attempt to determine, for a given type of farm, the differences between operating results when farms of various sizes are organized on a basis appropriate for each size of unit. To facilitate efficient combinations of the factors of production, the quality of the production factors, such as land, buildings, and machinery, is assumed to be the same for all sizes, and managerial skill to be adequate on all sizes. This ap-

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proach is useful in measuring the variations between efficiencies of different sized farms that are inherent in the size of the producing unit—the differences that would still remain if everything possible were done to improve the present levels of performance on actual farms.

It is obvious that farms of different sizes are not operated with the same efficiency. Some sizes have achieved, on the average, a better balancing of the factors of production than others. The quality of the factors may be different, too, on large and small farms.

This situation explains the need for a second kind of analysis. This analysis should consist of an examination of actual deviations from the planned models, which would indicate the possibilities of improving the productive efficiency on various sizes of farms.

Only by looking at the "economies of scale" in farming in both of these ways is it possible to avoid confusion between inefficiencies that may happen to exist on the smaller farms, but which, through education, guidance, and wisely directed capital investment, can be largely eliminated; and the increased costs that may be a necessary accompaniment to doing business on a small scale. Most studies of size of farms have not discriminated between these two major causes of inefficiency.

The objective of the present study is to find an answer to a question that can be phrased as follows: Are the possible combinations of productive resources so flexible that one size of farm can be about as efficient as another; or are there some favorable quantitative combinations of the factors of production that give a considerable advantage to farms of a certain size?

The importance of this problem in arriving at decisions on farm policy has been stated by T. W. Schultz (*41, pp. 2–3*).[2]

> I accept (the) goal of a family farm or ranch as the basic unit in agriculture. The family unit is traditional, and nearly all who think, write, and speak of it make their justification for the fact, and the concept, out of the predominant values of our time. We need, however, to know how close a family unit farm or ranch comes to best economic efficiency in the scale of its operations. The family unit ranch, even if small, may be productive enough of worth while individuals and social stability, but its scale of operations may be so small as to be economically costly. If many, or the typical, units are too small for their best economic performance the additional costs involved in their continuance may still be small when reckoned with their social productivity in mind. We do not know how large these extra costs are to society.

These "extra costs" are the principal concern of this study.

This study covers only one aspect of the broad problem of the relation of size of farm to resource efficiency. Attention is centered on the question of comparative production efficiencies among selected, equally well-planned, units that represent a range of sizes. The important problem of existing inefficiencies that arise as a result of less productive combinations of resources, particularly on small farms, is not treated here although this research does furnish a number of standards or "norms" that should be helpful in evaluating the extent of resource maladjustment on such farms.

The area selected for study is the corn-livestock farming area

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[2] Italic numbers in parentheses refer to Literature Cited, p. 52.

of northeastern Nebraska. This area permits the analysis of a complex system of farming and one which is rather typical of many farms in the United States.

The analysis is primarily based upon use of farm budgets in which only those inputs and outputs are allowed to vary for which it is reasonable to expect variation as a result of changes in size of farm. Use is also made of job analyses to arrive at conclusions regarding efficient combinations of factors of production. It might be called a planning, or engineering, approach to the problem of efficiency as related to size of farm.

Concept of the Farm

For an analysis of economies of scale it is desirable to define the farm in terms analogous to those commonly used in economic studies that deal with the individual firm. It is essential to distinguish between concentration of ownership and integration of production, as farmers often own or control more than one separate tract. Only if these are operated together, or are integrated to a substantial degree in the use of equipment and labor, should they be regarded as one farm.

For this kind of analysis the management and supervisory function should be performed by the farm operator if the farm is to retain significance as an organizing and planning unit. Other functions might not all be done on the farm. The analysis of a production operation might be in terms of internal economies if done on the farm and in terms of external economies if done on a hired basis.

In this report a farm is considered to be the integrated combination of land, labor, and equipment, used together under supervision of one person or agency in the production of farm products. (In the terminology of the literature on economies of scale this might be called a "plant".) The land may be in one or in several tracts so long as it is farmed with the same set of machinery, the same labor force, and under the same management.

Measurement of Size of Farm

For the budget analyses in the latter part of this study the number of year-round men is used as one measure of size of farm. This criterion is selected because it is a "lumpy" factor—not readily divisible. It is preferable to total labor input because it avoids the necessity of attempting to equate labor of varying capacities. This measure would be less useful if the comparisons to be made involved different types of farming.

Many of the useful applications of an analysis of size of farm have to do with the family-size farm and a classification in terms of labor inputs should be of more direct value than one made on some other basis. A subclassification in terms of size of the power unit is also used. Power is another important lumpy factor of production for most types of farming.

Although the analyses are in terms of 1-man, 2-plow tractor farms; 1-man, 3-plow tractor farms; 2-man farms, and so on, the description of present distribution of sizes of farms is mainly in terms of acres, because available statistics do not furnish a basis for a classification by labor force or input of power. Even if a labor-force classification were available it probably would exaggerate the size of small farms because of the under-utilization of the family labor force on such farms.

Theoretical Relationships Between Size of Enterprise and Efficiency

The purpose of this section is to provide a theoretical orientation with respect to relationships between size of enterprise and efficiency, to serve as a guide in the subsequent analysis of resource combinations.

Basic to this kind of analysis is an understanding of the concept of economies of scale. This is the term applied to certain kinds of decreasing costs (or increasing return) associated with increasing size of business (firm). The tendency toward increasing return may result from forces outside the firm or from internal forces. Marshall defines external economies as "* * * those dependent on the general development of the industry * * *:" and internal economies as " * * * those dependent on the resources of the individual houses of business * * * , on their organization and the efficiency of their management" (*29, p. 266*).

Internal economies of scale may be represented graphically by an

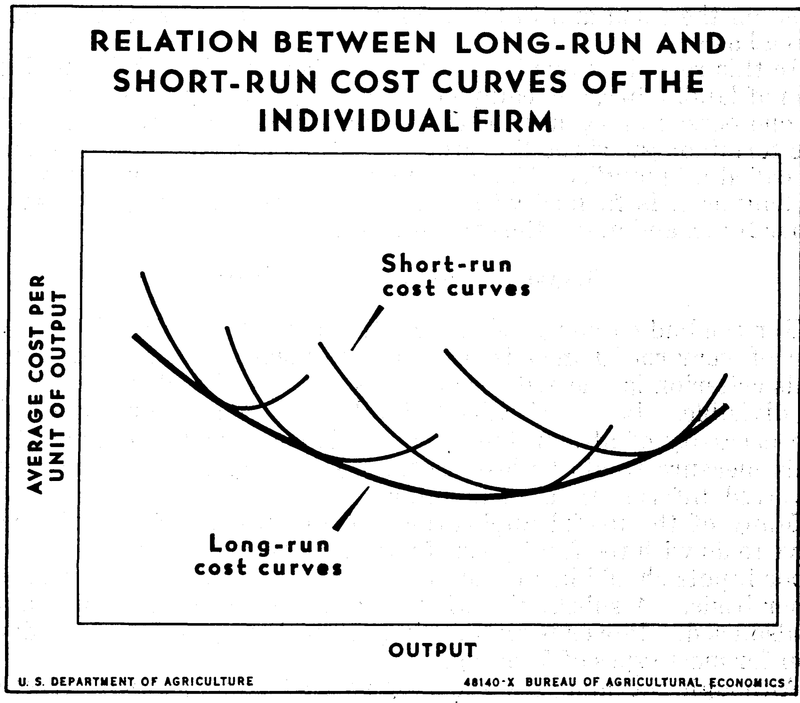

FIGURE 1.

array of individual firm cost curves (fig. 1). Each of these is merely a curve showing how efficiency varies with output when the quantity of a group of factors making up a "plant" (a producing unit) is held constant. The factors that are held constant are the ones the size of which is more or less fixed in the short run for the individual producer, like the acres of land in a farm, the size of power unit, the housing capacity of a barn, or the storage capacity of a granary. The curves differ from each other only in aggregate size of the group of factors that make up the producing unit. In each case it is assumed that these factors are combined in the proper proportions for most economical production for that size of unit.

In the long run, none of these factors is considered to be fixed in quantity. Therefore, under conditions of perfect competition, size of firm would be adjusted to the combination of all factors that would have the lowest cost. The long-run cost curve or economy-of-scale curve is a line tracing the points of lowest cost or highest economic efficiency on an array of short-run cost curves. [3]

In the short run the tendency for average costs to decline for a time, with increasing output, is due to a better combination of variable inputs with the fixed factors. This tendency acts most strongly when one or more factors are involved which are obtainable only in large units. With continued expansion of outputs, capacity of plant being fixed, average costs can be expected to increase, because of less favorable combinations of factors at successive outputs—the reverse of the situation of decreasing costs.

It is more difficult to state clearly the nature of long-run decreasing costs that may arise under the assumed condition that the entrepreneur has free choice in regard to quantities of all inputs. Some economists hold that these decreasing costs, like those in the short run, can be explained entirely in terms of indivisibility of factors, which leads to variations in the proportion of inputs. Others think that there are some economies of large-scale production that are more properly explained in terms of division of labor than by the law of variable proportions (*8, pp. 230–259*).

Most of the important advantages of large-scale business are explainable in terms of indivisible quantities of some of the elements of production. One economist says: "It appears methodologically convenient to treat all cases of large-scale economies under the heading 'indivisibility' " (*24*).

The existence of technical advantages of scale in an industry depends upon three sets of conditions: Division of labor, standardization, and division of management. One of the advantages which arises from division of labor includes increased skill and efficiency of labor resulting from continuous employment on one or a few jobs. Workers who concentrate their efforts on a few tasks learn to do them easily and quickly. Also, less time is lost in shifting from job to job. Another advantage lies in the possibility of selecting and assigning workers who have special aptitudes for jobs for which they are best fitted. The third major advantage in the

[3] For more complete exposition see any modern text on economics.

division of labor is that it permits each piece of equipment to be kept in use more of the time. Division of labor cannot be carried as far in agriculture as in many industries because of the physical separation of locations at which jobs must be performed and the strict seasonal and daily schedule that must be followed with most of them.

The possibilities for standardization apply to products of the firm, to methods of production, and to raw materials. Standardization of product permits distribution to a wider market with less selling effort and expense. Standardization of methods simplifies the task of supervision and increases the productivity of labor. Standardization of raw materials reduces the cost of searching out and testing suitable materials and reduces the responsibility of management in this respect. In general, standardization of product and of raw materials facilitates an increase in size of firm although it may not always result in lower average unit costs. Standardization of methods generally permits economies of scale.

In agriculture, products and raw materials can be standardized to some extent. Although, for most farm commodities, the grade to be produced cannot be predicted with complete accuracy until the production process is complete, most crop and livestock products can be sold on the basis of well-defined classes and grades, although there are important exceptions such as fresh market produce and purebred livestock. Most agricultural inputs—including feed, seed, gasoline, fertilizers, and many others—can be bought according to definite specifications; a few such as livestock, must be valued on the basis of judgment and appraisal. Opportunities for the standardization of methods on the farm are much more limited than in most industries. This fact is associated with the limited possibility for division of labor. The number of times any one job is performed by one worker in the course of a month or year is not great, except for a few jobs like milking on a specialized dairy farm or picking fruit in a commercial orchard. Therefore, the time that profitably can be spent in developing refinements in methods and in training workers in a standardized procedure is limited.

Closely akin to the division of labor is the division and specialization of management. The economies of scale related to division of management are largely explainable in terms of differences in the *QUALITY* of management. Large firms can afford highly skilled management; they can employ first-rate executives, and divide the work of management between several of them so that each can concentrate upon one phase of the business. Thus each enterprise may have its own branch manager. Other executives may devote their attention to the special problems of buying and selling or to the problems of personnel. With respect to management, a distinction must be made between economies of scale of the plant and of the business unit. Most of the types of reduction in costs previously mentioned are realized by changing the size of the industrial plant. Economies of management may be spread over several plants.

It is difficult to obtain a division of mental labor in small businesses because "assistant managers come in relatively large units and cannot be added in small quantities at a time as can land, labor and supplies" (*3, p. 316*).

But even in relatively large farm businesses, the economies of scale that are associated with division of managerial labor do not seem very pronounced. The same difficulties that limit division of manual labor apply here. Some of the large companies which manage farms on a fee basis are able to take advantage of some of the managerial economies of scale, but the contractual relations involved between management companies, land owners, and tenants, suggest that these are more nearly external economies than internal.

The tendency toward increasing return with greater size of business operates more strongly in some industries than in others. In all of them, a size is ultimately reached at which the increased efficiencies are offset by disadvantages, and average unit costs of production turn upward. These "diseconomies," as they are sometimes called, are to a considerable extent the result of the inability of management to keep pace with the expanding responsibilities of supervision.

Among the factors that tend to lower farming costs, but are external to the firm, might be mentioned the public experimental and extension work conducted by the State Agricultural Colleges and the United States Department of Agriculture; community or group services furnished for the benefit of farmers, such as rural electrification lines and roads; and the wide variety of custom services that arise with the development of an agricultural area.

These external economies influence the size of farms. The fact that most agricultural experimentation is conducted by public agencies with widespread dissemination of results among farmers, greatly strengthens the competitive position of small and medium-sized units. It is probable that farms in the United States would be considerably larger today if research had been financed by the entrepreneurs, thus giving to the farms that were the most able to finance research the advantage of superior knowledge.

The development of custom services generally improves the competitive position of the smaller farms by permitting them to hire the use of specialized machines or services. Thus a farmer with a small acreage of grain may hire combining done at a per acre cost, in normal times, that is considerably less than would be involved with ownership of the machine, although higher than the cost of operation on a large farm. Artificial insemination of dairy cattle is a notable example of a recently developing external economy that is improving the competitive position of small dairy enterprises. Other important custom services include hay baling, corn shelling, hauling, terrace building, and spraying.

Although the availability of custom services benefits the small farmer by reducing the necessary investment in equipment and in some cases the assembling of a large crew, use of such services has the disadvantage of reducing the amount of work to be done on the farm by the operator, often resulting in underemployment. But often the operator can hire some work done on his own farm, and acquire one or two expensive machines himself which he can use on his own and other farms.

The activities that have been discussed as "external economies of scale" differ from "internal economies" only in having developed outside of the firm. (Research, for example, is an important internal economy of scale in most industries.) In the main, the influence of these factors, if developed inside the firm would have been to encourage units of larger scale, whereas their development outside of individual firms has tended to offset some of the disadvantages of small-scale operation. As a possible avenue for publication to strengthen the competitive position of small farms, it might be worth while to encourage the expansion of the external economies of scale.

Previous Analyses of Efficiency as Related to Size of Farm

Size of farm has been recognized as an influential aspect of the farm business and has been given some consideration in nearly all farm-management studies. Most of these studies, however, are not primarily intended to be investigations of variations of size of farm.

Several studies have attempted to ascertain the size of farm that will meet some goal, such as to return an adequate living, to provide full employment for the family, or perhaps to permit economical ownership of some expensive machine. These usually make very limited comparisons between sizes of farm, attention being centered on one or two sizes that meet the desired requirements.

Only a few studies have approached the question of economic efficiency as related to the size of farm from the viewpoint of investigating the variations in input-output relationships that arise directly as a result of variations in size of farm.

STUDIES IN WHICH ANALYSIS OF SIZE OF UNIT IS INCIDENTAL

This group includes most farm-business analyses. It is a common practice in these studies to treat size of business as one of several management factors by which farms are sorted, when comparisons of net returns are made. In most such studies, labor income and net farm income tend to rise with increasing size of farm. But income per acre or per livestock unit often is highest in the middle-sized groups.

As analyses of functional relationships between size of farm on the one hand, and inputs and outputs on the other, most farm business analyses are of limited value. Findings from them are sometimes incorrectly used as a basis for decisions on policy as to desirable size of farm. These studies are likely to leave unexplained the extent to which the various correlations of management factors with size of farm may not be strictly a function of size of business. Small-scale farmers frequently are shown to have lower-than-average yields, or to be less successful in choice of crops grown, for example. These relationships sometimes appear simply because small farms happen to be located in areas where soils are poorer, or because operators of small farms may be less well informed than the average, or for any of several other reasons not inherent in scale of business.

Variations in size of farm are often accompanied by changes in type or intensity of some of the enterprises. If the economic efficiency of different sizes of farms is to be compared, the farms should all be of the same type. In some farm-business analyses, comparisons are made between size groups of farms that are not homogeneous with respect to type.

STUDIES OF A PARTICULAR SIZE OF FARM

Numerous studies might be listed as relating to a particular size of farm, widely varying in method and purpose, but with the common property of seeking to discover or describe a size of farm that will fit a preconceived standard, which may be of income, or of the amount of some factor of production, or perhaps one element of a factor of production.

If the study has to do with adequacy of income, the usual approach is more or less arbitrarily to select a "minimum" level of living and then set up sizes of farms of selected types that will provide this income under average circumstances. A process of farm budgeting is commonly used to arrive at these models (*40, 37*).

Studies of adequate income, such as the two mentioned, are helpful guides when action programs are being made, and to any person who wants to know how large a farm is needed, under given conditions, to provide a living. Even for these purposes, the principal weakness of them is that they do not indicate what results might be expected if the farm were somewhat larger or smaller. In other words, no clear picture is given of the relation of the farm described to the whole array of possible farm sizes for the same type. Present-day farming presents a complicated problem of combining a given family labor force with days or months of hired labor, pieces of equipment, units of livestock, and acres of land. Most of these are not obtainable in small increments. It seems illogical to approach the problem of resource combination from the viewpoint of income—the only completely continuous element in the equation. It would be more significant to start with the least divisible factor of production, ascertain the optimum quantities of other factors that should be combined with one unit of it, and then ascertain the net income to be expected from farms organized around one, two, three, or more units.

With development of expensive implements, attention has been given to the influence of farm machines on sizes of farms, and several studies have been made of the influence of particular machines on farm size and organization (*18*). These studies sometimes focus attention on some particular unit of organization which may not be the crucial determinant of farm size in the area studied. It might appear, for example, that a farm should have a certain number of acres of wheat to permit economical use of a combine. But farmers often hire part or all of their combining done. Or, if they own a combine that they cannot fully utilize, they may cut for their neighbors.

Some studies attempt to use full employment of family labor as the test of satisfactory size of farm (*9*). This type of analysis is helpful in answering the question of size of business that can be handled by a given labor force, but the evaluation of the capacity of family labor is difficult. Not only does family composition vary widely within an area, but effectiveness of individuals of any given age or sex is exceedingly variable.

Even though a satisfactory evaluation of the labor factor can be made, the lack of divisibility of other factors often may be more significant as a determinant of earnings.

ANALYSES OF ECONOMIES OF SCALE

Studies in economies of scale differ from the preceding in that they are not based upon a preconceived desirable relationship between the factors of production, or upon a fixed quantity of any one factor. Their purpose is to discover and explain the variations in cost of production associated with changes in size of farm. A careful scrutiny of the literature reveals very few studies that might be placed in this category (*11, 19, 20, 25, 39, 48, 53, 54*).

The methods of analysis employed in this group of studies include the synthetic construction of budgets, cross-classifications of individual farm data by size of business, analyses of Census data classified by value of products per farm, and derivation of production functions from individual farm data by statistical methods.

In general, the studies in this group show increasing net farm income with increases in size of farm. But the scale of observations is limited to a rather narrow range of sizes. There is a tendency to confuse increases in profitability with increasing returns to scale. Obviously, net farm income per farm can increase while "returns to scale" are declining.

Results from some of the studies in this group can be interpreted in terms of total input per unit of output. Generally the conclusions indicate increasing returns over the limited range of sizes covered by the studies.

As with other comparisons between sizes of farms, the validity of the findings from this group of studies is impaired by limitations in the basic data. Most effective from this point of view are the studies which depart from the use of historical data and deliberately attempt to develop sets of input and output relationships for different sizes of farms. [4] By this approach the influence of variations in managerial skill, quality of soils, location with respect to markets, and other factors not strictly a function of size of farm, can be minimized.

SIZE AND ORGANIZATION OF CORN-LIVESTOCK FARMS IN NEBRASKA

As background for the analysis of use of resources on farms of different sizes in northeastern Nebraska, information is given in

[4] This is the procedure followed in the Columbia Basin studies (*53, 54*) and in Montana Bulletin 278 (*48*).

this section concerning trends in farm sizes in the area, and the present organization of farms.

Trends in Size of Farm

The average size of farms in northeastern Nebraska has not changed much since the area was settled. In 1880, farms in five sample counties averaged 170 acres of land, compared with 181 in 1900 and 1920; 183 in 1940 and 186 in 1945.[5] The average acreage reported for 1945 is only 9 percent larger than it was in 1880.

A study of the distribution of farms by size groups since 1880 (table 1) shows moderate increases in the proportion of farms in groups with less than 50 acres, and in the two groups having between 175 and 499 acres. The proportion of farms falling in the 100- to 174-acre group shows a small decline. There has been a large drop in number of farms in the size group from 50 to 99 acres. The small proportion of farms having 500 acres or more has remained practically unchanged. There are a few more farms in these groups now than were reported in 1930 but the total number is smaller than it was from 1890 to 1910.

[5] Burt, Cuming, Dodge, Washington, and Wayne Counties. U.S. Bur. of the Census Reports.

TABLE 1.—*Distribution of farms by size groups, northeastern Nebraska, 1880 to 1945* [1]

Year	Size of farm group in acres															
	0–49		50–99		100–174[2]		175–259[3]		260–499		500–999		1,000 and over		Total	
	No.	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
1880	278	6.3	1,160	26.5	(........	....	2,842	64.9	....	........)	85	2.0	14	0.3	4,379	100
1890	394	5.7	1,580	22.8	(........	....	4,744	68.4	....	........)	172	2.5	43	.6	6,933	100
1900	686	8.3	1,396	16.9	3,436	41.6	1,415	17.1	1,123	13.6	175	2.1	30	.4	8,261	100
1910	634	7.8	1,132	13.9	3,343	41.2	1,622	20.0	1,239	15.2	137	1.7	14	.2	8,121	100
1920	456	5.8	1,035	13.2	3,451	44.0	1,645	21.0	1,137	14.5	109	1.3	12	.2	7,845	100
1930	724	8.5	988	11.7	3,574	42.1	1,827	21.5	1,272	15.0	90	1.1	9	.1	8,484	100
1940	685	8.3	924	11.2	3,495	42.3	1,673	20.3	1,343	16.3	120	1.4	14	.2	8,254	100
1945	794	9.8	746	9.2	3,194	39.3	1,877	23.1	1,369	16.8	136	1.7	11	.1	8,127	100

[1] Burt, Cuming, Dodge, Washington, and Wayne Counties, U.S. Bureau of the Census Reports.
[2] 100–179 acres in 1945.
[3] 180–259 acres in 1945. Data for 1880 and 1890 include farms from 100 to 499 acres.

In 1945, 39 percent of the farms in these counties had from 100 to 179 acres, 23 percent from 180 to 259 acres and 17 percent 260 to 499 acres.

Present Organization of Farms

About 70 percent of the land in farms in northeastern Nebraska is used for crop production. On the average, a little more than half of this is in corn, about 30 percent in oats or barley, and 8 or 9 percent in alfalfa. The remainder is used for other tame hays, wheat, rye, soybeans, and other crops. Nearly all farms grow corn, oats, or barley, and some kind of tame hay, usually alfalfa.

The production of large quantities of corn and other feed grains has encouraged the development of hog production and beef-fattening enterprises. More than half of the farm income of the area is generally derived from beef cattle and hogs and the two are of about equal importance in this respect. Other principal sources of income include the sale of feed grain, and dairy and poultry products. About 75 percent of the pigs are produced from spring farrowings, and are usually fed out on the farms where raised.

Many farms in the area have small breeding herds of beef cattle but, in the main, cattle production consists of the purchase and fattening of feeder cattle. Many of these are shipped in from the Sandhills of Nebraska. Both short- and long-feeding are practiced, with liberal grain rations. About 90 percent of the cattle marketed are of slaughter grades (*28, p. 48*).

Nearly all farms in the area have a flock of chickens and a small dairy enterprise. In many cases, the milk cows are of the beef breeding type and the calves are fed out on the farm. With this kind of enterprise the calves are hand fed, mostly on skim milk.

A random sample of corn-livestock farms in Cuming County indicated the following distribution of major enterprises in 1942. Corn was reported on all farms, oats or barley on 95 percent, sows on 84 percent, feeder cattle on 75 percent, milk cows on 99 percent, and poultry on 97 percent of the farms. Sixty-eight percent of the farms in this sample group had both cattle-feeding and hog enterprises. Only 5 percent did not have either feeder cattle or hogs (*table 22, p. 55*).

According to the type of farm classification in the 1945 Census of Agriculture, something more than half the farms in northeastern Nebraska were livestock farms, one-fifth were field-crop farms, and a little less than one-fifth were general farms. Together, these three types made up more than 90 percent of all farms in the area. They differed from each other mainly in the proportions, rather than choice, of enterprises.

The organization of corn-livestock farms, as shown by the Cuming County sample, is given in tables 2 and 3 for farms of different sizes. Table 2 shows that the proportion of farm land used for crops varied from 76 to 82 percent, and apparently did not tend to differ with size of farm. The percentage of cropland in corn ranged from 46 to 54 percent, of oats and barley from 22 to 28 percent, and of all tame hay from 12 to 15 percent. Among size groups, the proportional distribution of crops was rather similar.

TABLE 2.—*Use of land on corn-livestock farms, acreage per farm, by size of farm, Cuming County, Nebr., 1942*

Item	Size of farm group in acres						All farms
	0-99	100-139	140-179	180-259	260-379	380 and over	
Number of farms	13	10	41	27	14	6	111
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Total acres	80	125	159	207	306	472	194
Open pasture	7	18	18	38	59	72	30
Other noncrop land	10	8	11	13	14	27	12
Cropland	63	99	130	157	233	373	152
Corn	31	46	60	76	126	195	75
Oats and barley	14	23	35	41	55	104	39
Alfalfa and clover	8	11	12	15	23	37	15
Other tame hay	1	4	3	4	11	15	5
Rotation pasture	2	5	5	7	7	14	6
Miscellaneous and idle	7	10	15	14	11	8	12

TABLE 3.—*Livestock per farm on corn-livestock farms, by size of farm, Cuming County, Nebr., 1942*

Item	Size of farm group in acres						All farms
	0-99	100-139	140-179	180-259	260-379	380 and over	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Number of farms	13	10	41	27	14	6	111
Horses and mules[1]	2.6	3.1	4.2	4.0	5.7	9.2	4.3
Cows and heifers milked[2]	6.3	5.3	8.1	9.1	9.8	8.3	8.1
Cattle on feed[1]	6.5	29.1	17.9	22.2	107.4	42.7	31.3
Other cattle[1]	4.5	3.6	8.9	8.1	14.7	59.0	11.2
Sheep and lambs[1]	.3	....	1.0	2.5	.7	1.7	1.2
Sows farrowed:[2]							
Spring	5.4	5.5	11.6	11.3	20.4	15.7	11.6
Fall	1.3	2.2	2.2	2.6	4.4	4.5	2.6
Hens and pullets[1]	208.8	158.0	220.6	199.1	197.1	166.7	202.5
Chickens raised[2]	365.8	286.8	458.9	382.4	410.7	250.0	396.5
Total animal units[3]	30.5	52.7	58.4	62.9	169.2	128.6	73.6
Animal units per crop acre	.48	.53	.45	.40	.73	.34	.48

[1] On hand January 1.
[2] During year.
[3] Animal unit ratings; one horse, mule, milk cow, or animal on feed is counted as 1.0 animal unit. Other cattle, 0.65; pullets, 0.01; chickens raised, 0.003.

Table 3 indicates that the number of sows farrowed increased with size of farm except for the largest size group. Numbers of cattle fed varied considerably between groups but tended to increase with size of farm, although again the number fed in the largest size group was less than in the next size group. Numbers of cows milked averaged between 5 and 10 per farm. Numbers of poultry showed no significant difference between groups. Total numbers of animal units increased with increasing size of farm up to the group with 380 acres or more, but animal units per crop acre fluctuated considerably among size groups. The size group from 260 to 379 acres had the highest number of animal units per crop acre and the next larger group had the least.

USE OF LABOR, POWER, AND EQUIPMENT ON CORN-LIVESTOCK FARMS

From the standpoint of efficient use of any one resource, the desirable size of farm is the size which permits reasonably full utilization of that resource. From the standpoint of labor and machine efficiency the desirable size for a corn-livestock farm is one which permits full utilization of labor and field equipment during critical periods of the growing season, without interfering with timely performance of any of the work. There are certain jobs in crop production which must be done within a limited interval of time if optimum yields are to be obtained. The time required for these jobs, with a given combination of labor and equipment, determines efficient size of farm, disregarding, for the moment, the possibility that managerial skill may set a lower limit.

The crucial crop operations primarily determine the upper limits of efficient use of labor and equipment on corn-livestock farms, as livestock enterprises to a large degree are supplementary to crop production in use of labor.

Labor

The average composition of the labor force on farms in Cuming County is shown in table 4. The classification is based upon the number of year-round men, a year-round man being defined as a man rated at a full man equivalent who worked on the farm more than 6 months during the year. [6] In most cases these men were on the farm the year round. They represent the permanent labor force as distinguished from incidental help given by wives, school children and seasonal labor.

It will be noted that on the groups of farms up to and including 3-man farms, most of the work was done by family labor. The 4-man farms, on the average, had a small family-labor force, but almost two-thirds of the labor supply was of hired labor. There were only six farms in this group. [7]

[6] Man-equivalent ratings used are based upon ratings given by farmers in Cuming County on the 1942 farm-plan worksheets. The sample included 344 males and 292 females.

[7] A complete enumeration was made of farms reporting 3 men or more on the farm-plan worksheets. There was one 5- and one 7-man farm, not shown in table 5.

TABLE 4.—*Composition of labor force on farms, classified by size of labor force, Cuming County, Nebr., 1942* [1]

Size of labor force[2]	Farms	Man-equivalent months			
		Males in family 15 years old and over	Other family labor	Regular hired labor[3]	Total[3]
	Number	*Months*	*Months*	*Months*	*Months*
One-man	88	10.7	3.2	0.3	14.2
Two-man	27	20.6	5.1	3.6	29.3
Three-man	34	29.7	5.5	4.1	39.3
Four-man	6	15.3	3.2	31.8	50.3

[1] Data taken from random sample for 1-man and 2-man farms, and from complete enumeration for 3-man and 4-man farms.
[2] Farms classified by number of adult male workers employed for more than 6 months.
[3] Does not include seasonal hired labor.

Table 5 shows the way in which these four groups of farms are distributed by acreage. Wide variation is shown in all groups except for the 4-man farms. The modal sizes of 1- and 2-man farms are in the groups from 140 to 179 acres and of 3-man farms in the 260 to 379-acre group. All the 4-man farms exceeded 500 acres.

TABLE 5.—*Distribution of farms classified by size of farms, and by size of labor force, Cuming County, Nebr., 1942* [1]

Size of farm	Number of farms by size of labor force			
	One-man	Two-man	Three-man	Four-man
Acres:	*Number*	*Number*	*Number*	*Number*
0–99	13	-------	-------	-------
100–139	10	-------	-------	-------
140–179	27	13	3	-------
180–259	18	8	6	-------
260–379	8	4	15	-------
380–499	1	2	8	-------
500–up	1	-------	2	6
All farms	78	27	34	6

[1] See footnotes, table 4, for basis for classification and sampling.

Further evidence that size of business and size of labor force were not closely related is given in table 6, which permits a comparison of size of labor force and amount of work done. One-man farms had the largest number of productive man work units per man-equivalent. Workers on 2- and 3-man farms accomplished less work per man, and 4-man farms showed almost the same results as the 1-man group. This suggests that the labor force on 2- and 3-man farms, consisting largely of family workers, was greater than needed to handle the farm business, and was therefore underemployed. There was no apparent tendency to expand volume of business in these groups through intensification of livestock enterprises, the proportion of total productive work devoted to livestock being nearly the same for all groups.

TABLE 6.—*Productive man-work units per farm and per man-equivalent month, by size of labor force, Cuming County, Nebr., 1942* [1]

Size of labor force	Man-equivalent months	Productive man-work units per farm				Productive man-work units per man-equivalent month
		Crops	Livestock	Total	Percentage livestock is of total	
	Number	*Number*	*Number*	*Number*	*Percent*	*Number*
One-man	14	113	334	447	75	32
Two-man	29	129	416	545	76	19
Three-man	39	214	679	893	76	23
Four-man	50	465	1,083	1,548	70	31

[1] See footnotes, table 4, for basis for classification and sampling.

The man-equivalent ratings used in these tables were intended to measure effectiveness of the individual worker for general farm work during the actual time he or she was at work. A boy who worked on the farm 3 months during 1942, who accomplished as much during the time employed as an able-bodied man would have, was rated as one man-equivalent. Average ratings of workers, by age and sex, are shown in table 7. Data presented indicate that in the judgment of these farmers, a boy of 14 should do about half as much in a day as a man. Boys of 16 were rated at about three-fourths man-equivalent. By age 18 they were considered to be almost as effective as an adult worker. The estimates of increase in usefulness of boys with increasing age were much less variable than for declining labor effectiveness of elderly workers. Estimated capacity to do work began to decline at about 47 years. At

TABLE 7.—*Man equivalent rating of males and females in labor force for specified ages, Cuming County, Nebr., 1942* [1]

Age	Average man equivalent rating of —		Age	Average man equivalent rating of —	
	Males	Females		Males	Females
12	0.190	0.09	45	1.000	.37
14	.511	.17	50	.960	.28
16	.790	.21	55	.880	.24
18	.967	.25	60	.830	.18
20	1.000	.30	65	.760	.13
30	1.000	.35	70	.610	.12
40	1.000	.36	72	.500	.10

[1] Readings from smoothed curve based on 3-year average.

age 65, these farmers, on the average, rated themselves at about three-fourths of a man-equivalent, and half a man-equivalent at age 72. For girls and women, greater variability in work-effectiveness was reported at all ages. On the average, a maximum man-equivalent value of about one-third was reached at around 30 years. Capacity for farm work began to decline at between 45 and 50 years, according to these estimates.

In table 4, the family-labor force was broken into "males 15 years of age and over", and "other family labor". The proportion of the total man-months of labor supplied by women and younger children was 21 percent on 1-man farms, 17 percent on 2-man farms, 14 percent on 3-man, and 6 percent on 4-man farms.

Man-equivalent ratings of family labor do not adequately describe the contributions made by women and children on the farm. For some tasks that do not require heavy lifting or much strength they may be fully as effective as a man. This is often the case in jobs where a man and a boy can work together, and for most kinds of chores. A clearer picture of usefulness of various groups of labor on corn-hog farms is given in table 8, which shows the desirable minimum crews for doing specified jobs under given conditions of equipment. By minimum crew is meant the minimum working force for effective performance of the work with respect to both quality and quantity of output. Jobs indicated as being suitable for a boy might be thought of as those which a farm boy of 12 or 14 years could do well enough and without too much effort for his age, even though a man might do the work somewhat better and more quickly. Data collected in this study indicate that boys under 12 years of age do little farm work.

Most of the information given in table 8 was obtained from interviews with seven farm operators in northeastern Nebraska. No information was obtained for the beef-cattle feeding enterprise.

TABLE 8.—*Desirable minimum crew for specified jobs and equipment on a corn-hog farm*

Enterprise and job	Equipment	Crew[1]
Crop enterprises:		
Selecting and buying seed		One man[2]
Treating seed	Hand mixing or dipping	One man and one boy
Hoeing		One boy
Plowing, harrowing, stalk-cutting, disking, packing, planting, drilling, cultivating, mowing and raking	Tractor-drawn equipment	One man
Picking corn and storing on farm	1-row picker and tractor, 2 trailers and tractor, elevator	Two men
	2-row picker and tractor, 2 trailers and tractor, elevator with motor (for hauling more than 2 miles will need additional tractor and trailer, and man)	Three men
Combining grain and storing on farm	Tractor and combine with grain tank, 1 pick-up truck or tractor and trailer elevator	Two men
Stacking hay, loose	Overshot stacker with tractor or pick-up, power buck	Three men and one boy
Putting up baled hay	Automatic pick-up baler and tractor, 3 trailers and tractor, bale elevator or sling and motor	Five men
Hogs:		
Feeding sows and pigs	Hand feeding	One boy
Hauling feed and water	Team and wagon	Do.
Hauling feed and water	Tractor and wagon	One man
Bedding sows and pigs		Do.
Set up and arrange farrowing quarters		One man and one boy
Move sows into farrowing quarters		Do.
Care for sows at farrowing		One man[2]
Sort feeding pigs		One man and one boy[2]
Loading and hauling pigs	Truck	Do.
Castrate pigs		Do.
Vaccinate pigs		Do.
Wean pigs	Build creep for self feeder	One man
Breed sows		Do.[2]
Move sows to winter quarters		One man and one boy
Family milk cows:		
Milking	Hand	One boy
Feeding		Do.
Care of calf		Do.
Artificial insemination	Done by association technician, aided by operator	Two men[2]
Farm poultry flock:		
Feed and water		One boy
Gather eggs		Do.
Cull hens		One man[2]
Select and order baby chicks		Do.[2]
Brooding chicks	Electric brooder	One man[2]
Pack eggs for market		One boy
Grading eggs		One man[2]
Miscellaneous:		
Fixing fence		One man and one boy
Repair machinery and buildings		Do.
Repairs; well and water system		Do.
Hauling manure	2 spreaders, 2 tractors, 1 loader	Two men
Mixing and grinding feed	Power grinder, blower elevator to bins	One man
	Power grinder, bagging attachment	Two men

[1] Boys from about 12 to 14 years old can usually do satisfactorily the jobs indicated as being suitable for boys. Older boys as a rule can do the same jobs as adult workers although their efficiency may be lower.

[2] Indicates jobs in which it is highly desirable for the farm operator to participate.

The 45 jobs analyzed are operational, as distinguished from managerial or planning activities involved in running a farm. "Men", includes boys 15 years old or over. This was mentioned most frequently by the interviewed farmers as the age at which boys could be expected to do a man's work with a tractor, although one farmer reported that his own sons began operating tractors on field jobs when 12 years old but he considered this to be too young to be desirable.

Out of 16 crop-production jobs, only one is considered suitable for boys working alone on tractor-operated farms. With horses, several more field jobs would drop into this category. Eleven are 1-man jobs; one is suitable for a man and a boy working together; two are 2-man jobs and one—putting up hay with an automatic pick-up baler—is a 5-man job. However, if this job were done with an overshot stacker and power hay buck, the desirable minimum size of crew would be three men and a boy.

For livestock production, 8 out of 24 jobs can be done by boys, 9 are 1-man jobs, and the remaining 7 can be done reasonably well by a man and a boy. The 5 miscellaneous jobs include a 1-man job, 3 jobs for a man and a boy, and a 2-man job, loading and hauling manure with a tractor loader.

The farmers who were interviewed were asked to indicate jobs in which participation of the farm operator was likely to give better results than would be obtained if the work were done by reasonably well-trained hired or family labor. Only one crop-production job was indicated—selection of seed—but the presence of the operator was suggested for 10 livestock jobs. These are the jobs that require the greatest skill and knowledge.

Managerial and planning jobs, which were not considered, would of course be done largely by farm operators, with some participation by other family members.

Although many arguments have been advanced in recent years with respect to advantages of a 2-man labor force, it appears that on a corn-hog farm most of the work can be done about as well by a man and a boy. One man working alone is at a disadvantage in accomplishing 15 of the 45 jobs considered.

The labor force of the average farm family is about equivalent to a man and a boy. However, there would be periods during the family cycle when the effective labor force would be reduced to one man, including the time before the children were of working age, periods when they were at school, and, in many cases, the years after they had grown up and left home. Then too, the children may all be daughters, which may reduce the labor contribution of the family. The main advantages of a full 2-man farm are likely to follow from uniformity in labor supply over a period of years in comparison with that on a strictly family-operated unit.

Power

Power resources on corn-livestock farms are in a continual process of being adapted to changes in equipment. To some extent this process is a two-way adjustment. The existing source of power influences the choice in selection of new equipment; and in the same way the present line of implements influences the selection of a new tractor.

Of 135 farms in northeastern Nebraska for which information is available for 1944, only five did not have a tractor, 105 had one tractor, 24 had two, and 1 had three (*15, p. 12*). All but two of the surveyed farms reported horses, the average number per farm being 3.9.[8] Twenty-eight percent of the tractors on the sample farms were rated at from 9 to 12 drawbar horsepower; 53 percent from 15 to 18, and 19 percent at more than 18.[9]

Of the 24 farms having two tractors in 1944, there were 12 on which both tractors were rated at 15 drawbar horsepower or more; 10 on which one tractor was of less than 15 drawbar horsepower and one larger; and two on which both tractors were of less than 15 drawbar horsepower. (Most of the two-plow tractors produced in recent years have a drawbar rating of 15 horsepower or more.) These data indicate that on something less than half the tractor farms, differences in size permit the operator some flexibility in matching the power unit with the capacity of each job. However, on 14 of these 2-tractor farms 1 tractor was more than 10 years old in 1944, and for 10 of them, more than 15 years old. Acquisition of two tractors is probably as much or more a matter of buying a new one and keeping the old, as of planned maintenance of two power units each of the proper size and type for the various jobs to be done on the farm. Power for most of the light jobs is still furnished by horses, in this area.

A comparison of size of farm and total draft power available indicates that amount of draft power per crop acre declined sharply as size of farm increased (table 9).[10] Farms with more than 200 acres of cropland had only a little more than half the draft power per hundred acres that was used on farms of 120 acres or less.

TABLE 9.—*Relation between acreage of cropland per farm and draft power, northeastern Nebraska, 1944*

Size of farm crop acres	Farms[1]	Acres in crop-land	Tractor drawbar horsepower: Rated	Tractor drawbar horsepower: Horse-equivalent[2]	Horses, number	Total draft power, horse-equivalent	Horse-equivalent draft power per 100 crop acres
	Number	*Acres*	*Rated*	*Horse-equivalent*	*Number*	*Horse-equivalent*	*Horse-equivalent*
0–120	20	93.3	12.7	4.2	3.6	7.9	8.5
121–200	39	157.3	18.3	6.1	4.0	10.1	6.4
201–up	25	226.0	23.2	7.8	4.5	12.3	4.6
All classified farms	84	174.7	18.4	6.2	4.1	10.3	5.9

[1] Farms were excluded from this tabulation if tractors were more than 10 years old because many of these older tractors are not used extensively.
[2] Assuming one rated dbhp equal to 0.34 horse.

[8] One farm excluded from this tabulation, because the data did not show whether horses were used or not.
[9] Drawbar horsepower (dbhp) ratings referred to in this study are taken from the Nebraska rated load tests (*34*).
[10] Total draft power was calculated by assuming that a two-plow general purpose tractor could do the work of about 5.5 horses. Average rating of tractors used with two-plow equipment in northeastern Nebraska was 16.4 dbhp.

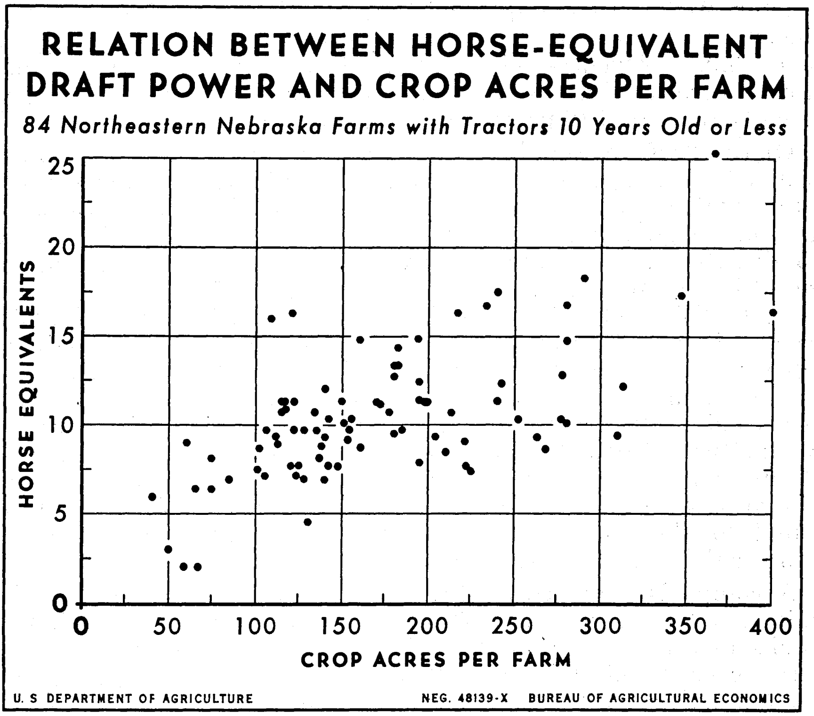

FIGURE 2.

But figure 2 shows that there is great variability in power resources actually found on farms of any given size. To some extent this may be due to variations in power requirements because of differences in intensity of operation or size of the labor force, or in extent of custom work done by others on the farm or for others off the farm. It appears from inspection of the records that custom work would not be enough to explain very much of the variation in available power. To a large extent it appears to be a matter of incomplete adjustment arising from a variety of causes. In some cases, tenants equipped for a given size of farm move to one of a different size. Some farmers, laying plans for expanding operations, buy a large tractor with the idea of increasing their acreage. Others have added a tractor but have not yet reduced their number of horses. Frequently, a large tractor is acquired in order to pull one large machine such as a two-row corn picker, although other jobs on the farm do not need so much power. Farmers generally believe that a substantial reserve of power is desirable in order to permit them to operate when the conditions of the soil are unfavorable.

Corn-livestock farms need two sources of power, a principal one consisting of either a two- or three-plow tractor, and a small tractor or a team. With only one power unit a farmer loses the flexibility needed for timely and efficient performance of such operations as haying, harvesting grain, and picking corn. It is desirable to do some jobs simultaneously, as may be the case with cultivating corn and cutting or raking hay; or, cultivating corn and combining grain.

Machinery

Sizes of the more common tractor-drawn implements on farms in northeastern Nebraska are shown in table 10 in relation to size of tractors. Horse-drawn implements are not included in the table, which explains the small number of harrows, planters, and mowers. Farms are classified by size of the largest tractor owned. If more than one implement of a given kind was reported, classification is based upon the largest size.

A range in size was reported for most implements, but the outstanding conclusion to be drawn from this table is the tendency for one single size to predominate, without reference to the size of tractor. For plows, a two-bottom size was most common. Even with the larger tractors, 60 percent of the farmers had this size of plow. No one-bottom plows were reported, although several of the small tractors on these farms are usually regarded as adequate only for this size. No information was obtained as to width of plow bottoms. They probably tended to vary with size of tractor.

With small tractors, a 10-foot disk was the most common size. For medium-sized tractors, the 15-foot size was somewhat more numerous than the 10-foot size. With large tractors, most disks were 15 feet wide, although some 10-foot machines were reported. There were few disks of other sizes. Only two or three tandem disks were reported in the entire sample.

TABLE 10.—*Number of farms reporting specified tractor-drawn implements, by size of largest implement and size of largest tractor, northeastern Nebraska*

Implement and size	Farms reporting: Total	With tractor 9–12 dbhp (average 10.3)	With tractor 12–18 dbhp (average 15.9)	With tractor 19 or more dbhp (average 23.5)
	Number	*Number*	*Number*	*Number*
All specified implements	128	16	66	46
Plows, all	122	15	61	46
2-bottom	99	14	57	28
3-bottom	23	1	4	18
Disks, all single	81	15	42	24
9-foot	3	1	1	1
10-foot	30	8	15	7
11-foot	3	1	1	1
12-foot	4	1	3	
14-foot	7	3	3	1
15-foot	34	1	19	14
Harrows, all	21	2	12	7
3-section	2	1	1	
4-section	19	1	11	7
Cultivators, all	118	13	63	42
2-row	112	13	61	38
4-row	6		2	4
Grain drills, all	15	1	6	8
8-foot	2			2
9-foot	3		2	1
10-foot	4		2	2
11-foot	3		1	2
12-foot	2		1	1
14-foot	1	1		
Corn planter, all	29	5	11	13
2-row	25	5	10	10
4-row	4		1	3
Listers, all	34	5	15	14
2-row	34	5	15	14
Mowers, all	30	4	15	11
5-foot	1	1		
6-foot	2		2	
7-foot	27	3	13	11
Combines, all	12	1	5	6
5-foot	8	1	3	4
6-foot	3		1	2
12-foot	1		1	
Corn pickers, all	26	1	11	14
1-row	8	1	3	4
2-row	18		8	10
Grain binders, all	76	7	38	31
7-foot	11	1	7	3
8-foot	42	5	19	18
10-foot	23	1	12	10

Nearly all of the few harrows reported consisted of four sections. These would cover a width of from about 16 to 20 feet, depending upon make and model. Only 6 of a total of 118 cultivators covered four rows, the rest being two-row machines. There were 4 four-row planters out of 29. All the listers were of two-row capacity. Usually, the row capacity of cultivators on a farm is the same as for the planting equipment, although corn planted with a two-row lister can be successfully worked with a four-row listed corn cultivator if the rows have been carefully made. With a two-row lister, the last cultivation is usually with a two-row wheel-type cultivator. The advantages of two-row over four-row equipment on rolling fields were frequently mentioned by farmers. The winder equipment is said to make it more difficult to maintain an even depth of seeding and tillage on sloping ground, and it is more difficult for the operator to watch the performance of a four-row machine. Although the four-row surface planter is a light-draft implement, the four-row lister needs more power than the usual three-plow row-crop tractor will furnish.

The 15 grain drills reported were of widely varying size. The 10-foot drill was the most common width. Nearly all the tractor mowers had a 7-foot cut, and the most common size of combine had a cutting width of 5 feet. Grain binders were mostly older horse-drawn models, converted to tractor draft; they did not show any significant size relationship to size of tractor. The 8-foot binder was the modal size.

Of 26 corn pickers, 18 were of two-row capacity and almost half of these were drawn by two-plow tractors. Some of the farmers planned to get larger tractors for their two-row pickers.

The matter of personal preference has great weight in choice of sizes of equipment. Individuals vary in their capacity to handle a machine. Some work most effectively when equipped with a machine of narrow width traveling at above-average speed. Others prefer a greater width and slower speed. It is a generally accepted belief that implements and tractors ought to be adapted to the individual operator, particularly with respect to speed. If the machine moves too slowly the operator becomes bored; if too fast, he becomes exhausted (*38, p. 174*). Very little is known as to the desirable size-and-speed combination for the average operator, or for different kinds of operators. This problem needs further study. Although it is true that "the man who turns one furrow does not deserve and can hardly hope to secure the same earnings as if he turned three," (*1*) it has not been demonstrated that the same man can do both with equal facility. Interviews with farmers in northeastern Nebraska indicated that there was little difference in strength and skill required in operating two- or three-plow tractors equipped with hydraulic controls, for most farm operations. The small one-plow tractors were said to be considerably easier to handle and were considered practically ideal for training young or inexperienced workers.

Desirable Sizes of Field Equipment

The question of desirable size of equipment for a given farm may be approached in the following way. First, the size and kind of power unit must be decided upon. Second, the optimum load for the power unit should be determined in relation to existing conditions of soil, topography, and size of fields. Third, information should be assembled for each size of implement concerning the amount of work that can be done in a day. Then, for the major items of equipment, curves should be developed showing the relationship between acres covered and cost per acre.

Nearly all tractors in this area are of the row-crop type. This type is available in sizes that can be roughly classified as three-plow, two-plow, one-plow, and small one-plow (one-row) tractors.

Choice of power unit has been rather fully covered by the previous discussion. The one-plow and smaller tractors would not seem to be desirable as the major source of power on most farms in the Corn Belt, if the objective is to set up a fully mechanized farm. A few small tractors are reported as drawing combines, pick-up hay balers, and corn pickers, but they are generally considered inadequate for these jobs. There does not seem to be any strong reason why an able-bodied man should limit his capacity to sizes of equipment that can be drawn by a small tractor. The most common present size of tractor in the area is one capable of pulling two 14-inch plows, but there are a considerable number of three-plow tractors and plans of farmers indicate a relatively greater increase in numbers of these than of the two-plow machines. As the actual practice in this area indicates little difference in sizes of equipment drawn by these two sizes of tractor, the choice between them might be largely governed by soil and topographic conditions on the individual farm.

Information regarding present sizes of equipment in relation to size of tractor is summarized in table 10. Using the modal sizes shown in this table as a guide, a list of typical sizes of implements is set up for each size of tractor (table 11). Only the principal implements used in the area are shown. Sizes given deviate from present modal sizes only to the extent that information obtained in the study indicated that a change was in process or would be desirable. This information included survey data on intentions of farmers to buy implements of various sizes, case studies of individual farms, and interviews with agricultural engineers at the University of Nebraska and with representatives of farm-equipment wholesale distributors.

The sizes of machines shown in table 10 are based upon average conditions of soil and topography. No consideration is given to unusually small or irregularly shaped fields that might require smaller equipment. For some of the items listed the size given is not the largest that could be drawn by the tractor, but is as large as would be wanted by most farmers in view of the work to be done. This is true of grain drills, for example. Also, it is possible that the three-plow tractor would pull wider harrows, packers, and disks, than the sizes shown; but in this area the greater difficulty in making turns and getting through gates and down farm lanes, would probably offset any advantage in time saved in the field. On the more level fields, a three- or four-row lister and comparable sizes of cultivators would be more desirable for the large tractors. They are not used in the budgets because of the limited interest that farmers seem to have in them and the reported difficulties in using them on rolling land.

TABLE 11.—*Typical sizes of equipment for tractors of various sizes, under average working conditions, northeastern Nebraska*

Implement	Size of tractor		
	One-plow (9–12 dbhp)[1]	Two-plow (13–18 dbhp)[1]	Three-plow (19–30 dbhp)[1]
	Size	*Size*	*Size*
Plow	1–16 inch	2–14 inch	3–14 inch
Disk, single	10-foot	15-foot	18-foot
Harrow	16-foot	20-foot	20-foot
Packer	9-foot	15-foot	17-foot
Drill	8-foot	10-foot	12-foot
Mower	7-foot	7-foot	7-foot
Side delivery rake	12-foot	12-foot	12-foot
Lister		2-row	2-row
Cultivator, wheel type	2-row	2-row	2-row
Cultivator, listed corn	2-row	2-row	2-row
Corn picker		1-row	2-row
Stalk cutter	3-row	3-row	3-row
Combine		5-foot	6-foot

[1] Dbhp = drawbar horsepower.

Information is available from several studies concerning the amount of work, according to farmers' estimates, done in a day with a given size of machine.

This information also can be approximated by calculating the acreage that can be covered in a day by a machine of given width, traveling at a given rate of speed. This relationship can be expressed by a formula:

$$\text{Acres covered per hour equals } \frac{(5280)\ (\text{speed, m.p.h.})\ (\text{width, feet})}{43{,}560}$$

This reduces to: (0.12) (speed, m.p.h.) (width, feet)

This formula makes no allowance for wheel slippage, and for time lost in servicing the machine, in making turns, or in overlapping part of the width.

An adaptation of the above formula rather commonly used is:

Acres covered per hour equals (0.10) (speed, m.p.h.) (width, feet); which for a 10-hour day, reduces to speed multiplied by width (*27, pp. 55-57*). This formula implies a time loss of 17.5 percent. According to a Kansas study, however, actual performance reported by farmers was about 20 percent less than the figure calculated from this formula (*13, p. 15*).

It is generally thought that, where adequate survey data are available, the rate of performance as reported by farmers is a more satisfactory guide to amount of work that can be done with a given size of machine than is a calculated figure. Estimates for northeastern Nebraska are summarized in table 23 (p. 56). These figures are based upon survey data, adjusted for local conditions and increased by an average of 20 percent to allow for time lost in overhauling machinery, in moving from field to field, and in jobs that require less than a full day.

Table 23 also shows the usual size of crew and the range in tractor horsepower for which the assumed rates of performance would be valid.

Several farm-management studies indicate that the time required to perform various field operations with a given size of implement is greater on small fields than on larger ones (*2, 12, 33*). But the more recent studies indicate that, with the small general-purpose tractor, the increase in time required is relatively small.

The next step in analyzing the relationships between machinery and size of farm is to ascertain costs of equipment per crop acre. This involves consideration of both overhead and operating costs. For the principal farm machines used in this area, information concerning approximate cost when new; and concerning annual depreciation and repair costs, has been assembled in table 24. For most items, repair costs are expressed as yearly costs. It would be more nearly accurate to state them in terms of hours of use, or acres covered, because repairs are more closely related to use than to time. This has been done for the major items—tractors, trucks, automobiles, combines, pick-up balers, and corn pickers.

Operating costs for tractors are given in table 25 and for corn pickers, combines, pick-up hay balers, and automobiles, in table 26.

Cost schedules, based upon the given costs and duty rates, are shown in figures 3, 4, and 5, for tractors, corn pickers, and combines. These figures are taken from a study of machine depreciation based upon the same data that have been discussed here (*42, pp. 69–77*). It is concluded in that study that the per acre cost of operating most farm machines declines rapidly with increasing use, over a limited range; that it declines only moderately with still greater use; that ownership involves a lower cost per acre than usual custom rates even for relatively small acreages; and that, where a larger machine permits a considerable saving in time per acre, costs per acre for the larger machine are likely to become lower than for the smaller one, with a rather small amount of annual use. This is because the saving in time results in lower costs for labor and power per acre.

It appears that moderate-sized farms well within the range of family-operated units can avail themselves of most of the benefits associated with economies of scale in the use of machinery.

A good many farmers own one or more of the expensive items of equipment in cooperation with a nearby farmer. Information regarding cooperative use of equipment is not available for Nebraska. According to an Iowa study, (*21, p. 100*), machines most commonly owned cooperatively were combines, corn pickers, ensilage cutters, grain elevators, trucks, tractors, rollers, rakes, grain binders, corn shellers, and grain drills. No information was given for ownership of hay balers, choppers, or stackers. Almost three-fourths of the combines, and more than one-half of the corn pickers were used on other farms. For most machines, use was limited to two or three farms, although combines were used on an average of 5.5 farms and corn shellers and ensilage cutters on from 18 to 20. Joint use of equipment is a noteworthy means of reducing the investment in farm machinery.

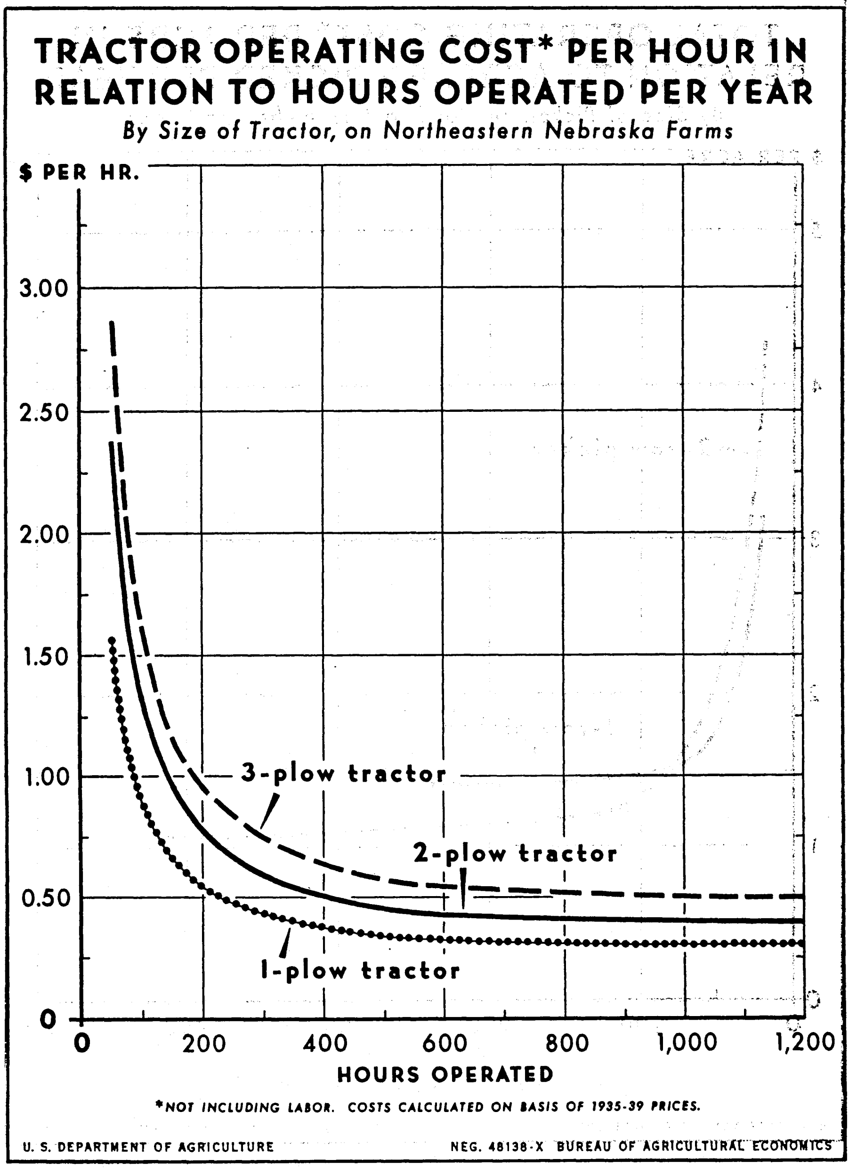
TRACTOR OPERATING COST* PER HOUR IN RELATION TO HOURS OPERATED PER YEAR
By Size of Tractor, on Northeastern Nebraska Farms
$ PER HR.
3.00
2.50
2.00
1.50
1.00
0.50
0
3-plow tractor
2-plow tractor
1-plow tractor
0
200
400
600
800
1,000
1,200
HOURS OPERATED
*NOT INCLUDING LABOR. COSTS CALCULATED ON BASIS OF 1935-39 PRICES.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 48138-X BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 3.

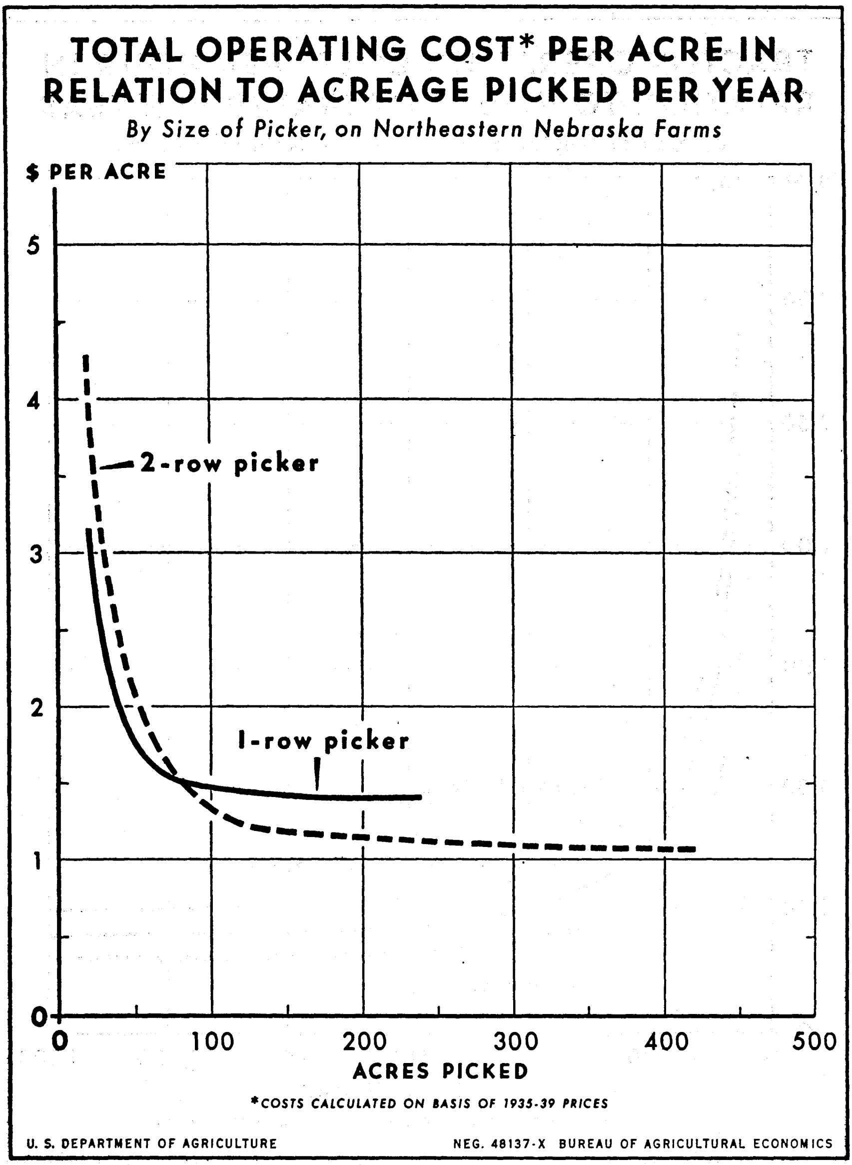
TOTAL OPERATING COST* PER ACRE IN RELATION TO ACREAGE PICKED PER YEAR
By Size of Picker, on Northeastern Nebraska Farms
$ PER ACRE
5
4
3
2
1
0
2-row picker
1-row picker
0
100
200
300
400
500
ACRES PICKED
*COSTS CALCULATED ON BASIS OF 1935-39 PRICES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 48137-X BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 4.

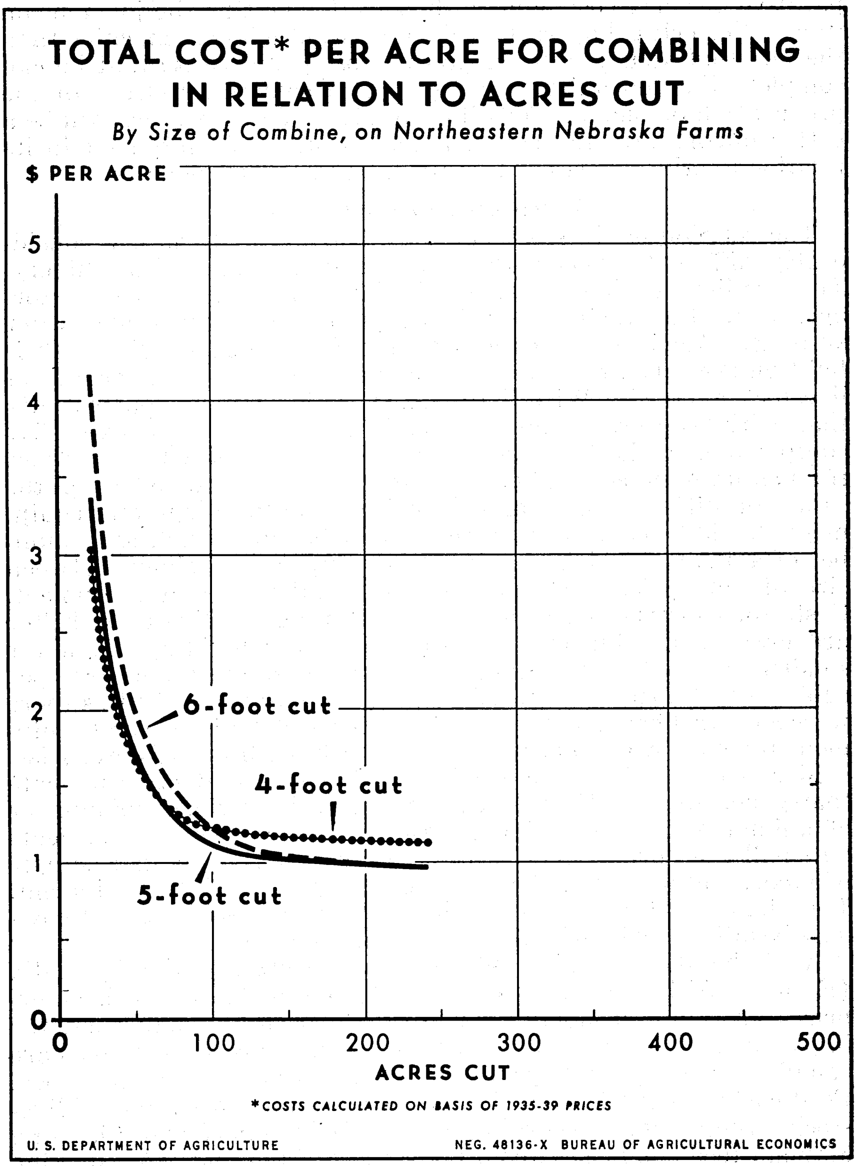
TOTAL COST* PER ACRE FOR COMBINING
IN RELATION TO ACRES CUT
By Size of Combine, on Northeastern Nebraska Farms
$ PER ACRE
5
4
3
2
1
0
6-foot cut
4-foot cut
5-foot cut
0
100
200
300
400
500
ACRES CUT
*COSTS CALCULATED ON BASIS OF 1935-39 PRICES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 48136-X BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 5.

No further attempt is made here to deal quantitatively with decreasing costs in use of machinery. Combinations of equipment that are possible on farms of a given size are flexible. A farmer decides how large a machine he ought to have on the basis of comparative per acre costs and on the need for getting the job done on time. For critical operations, he may want a larger machine than the one that would result in lowest cost per acre, so that he can complete the job quickly and go on to something else. In the preparation of budgets for different sizes of farms there will be a better opportunity to deal with the question of equipment in its relation to other phases of investment and operating costs.

Buildings and Equipment

The relation of livestock equipment to size of farm is a considerably different problem than is true in the case of machinery. There is little standardization of buildings for shelter or feed storage, or of other facilities used, such as feeders, fences, and water systems. Much of the capital equipment needed for livestock is built on the farm, resulting in wide variations in costs per unit of livestock handled. With livestock, there is a greater opportunity than with crop production, to substitute hand labor for expensive equipment or makeshift shelter for elaborate buildings. However, if an assumption is made that livestock practices should be kept the same for different sizes of enterprises, and buildings and equipment should be equally convenient and efficient regardless of number of animals cared for, some relationships can be shown between size of enterprise and unit costs for buildings and equipment. Costs for constructing barns for hay storage and livestock shelter are lower per cubic foot of space for large buildings than for smaller ones. This is because of the decrease in surface area per cubic foot of space with increasing size of building. Unless there were a central hog house, costs of constructing buildings and equipment for hogs would not vary significantly with size of enterprise.

Most studies of the use of labor in livestock production indicate that generally, less time is required per animal when the number of animals cared for is large. But reported labor requirements on small enterprises may be high because of an abundant supply of labor, and labor may be substituted for some of the equipment. Thus hand feeding may take the place of self-feeders, and cows may be milked by hand rather than by a machine.

Available data on labor inputs are scrutinized in the Appendix (p. 55). Although it seems evident that large livestock enterprises are more economical in use of labor than small ones, the importance of this can be overemphasized. Direct labor costs are usually a rather small part of the cost of producing livestock. Feed costs are the largest item of expense for most kinds of livestock production. According to the Nebraska Farm Planning Manual, feed comprises about 80 percent of the cost of production for hogs and fattening cattle, 70 percent for beef breeding herds and sheep, 60 percent for dairy cattle, and 50 percent for poultry, under average conditions (*36*). Savings in labor associated with the production of feed are likely to be more important than savings in direct livestock labor.

In addition to livestock equipment, most corn-livestock farms have granaries, shops, garages, and, of course, a dwelling. These vary greatly in arrangement, size, and construction. Granaries may be inexpensive, shed-type structures, or they may be of a central drive-way type with inside elevators and overhead bins. Many farms have one granary with central driveway in which small grain, feed, and part of the ear corn, can be stored. Additional space for ear corn is usually provided in slatted cribs. Costs of constructing granaries should be somewhat lower per bushel of capacity in the case of the larger structures. Garages and shops are frequently combined in one building, occasionally including some space for storing machines.

The investment in dwellings is one of the major reasons for higher building costs per acre on small farms compared with larger ones, particularly if the larger farm does not furnish housing for all of the labor force. In this case, the lower costs are not truly a result of economies of scale. They arise from a shift in costs from a fixed investment in housing to increased variable costs due to a higher wage rate.

Significance of relationships between size of farm and building and equipment costs, is examined in more detail in connection with the budgets presented in a later section.

INFLUENCE OF EQUIPMENT ON EFFICIENT SIZE OF FARM

Thus far the discussion has been in terms of kinds of equipment needed on corn-livestock farms; equipment capacity and costs; and relationships between costs and amount of use. The purpose of this section is to examine the ways in which available sizes of equipment influence size of farm. This problem involves cropping systems and practices, sizes and capacities of field equipment, and time available for field work.

Assumed Organization and Practices

The system of farming assumed in this analysis is similar to that shown in tables 2 and 3. Minor enterprises have been omitted and crop acreages are based on an assumed rotation with 57.1 percent of the cropland in corn, 28.6 percent in oats or barley, and 14.3 percent in alfalfa. Each year, an average of 3.6 percent of the cropland would be seeded to alfalfa, and 10.7 percent to sweetclover. Oats would be sown with these as a nurse crop. The remaining 14.3 percent of the small-grain acreage would be barley. Compared with the average distribution for Cuming County (table 2), this rotation calls for a little more corn and would be higher than desirable on farms in more steeply rolling parts of the area. The acreage in oats and barley is also somewhat above the acreages shown in table 2, but the assumed organization does not contain any of the miscellaneous crops listed.

Acreage of alfalfa is somewhat below the reported totals of hay and rotation pasture, but the acreage assumed to be planted in green-manure crops is higher than the average for the area. This rotation provides about as large an acreage in legumes as is recommended for the area, in view of the tendency for alfalfa and sweetclover to reduce subsoil moisture. In actual practice this rotation would not be followed precisely year after year. Alfalfa would tend to be planted in more favorable years, and might be left on the ground longer than 4 years if the stand continued to be good. It is assumed that hog lots are on part of the alfalfa, in the regular rotation.

The distribution of crops in the assumed rotation is rather similar to a recommended cropping system for this type-of-farming area, which includes corn on 53 percent of the cropland, oats and barley on 27 percent, legume hay and pasture on 16 percent, and 4 percent in miscellaneous crops (*16, p. 8*).

Eighty percent of the farm is assumed to be in crops, 15 percent in permanent pasture, and 5 percent in farmstead, waste, and woods. These proportions are about the same as on the average farm in the area (table 2, p. —).

Crop and livestock practices assumed in the budgeting analysis are based upon published results of experimental studies and upon suggestions of specialists in crop and livestock production.

For corn production on land that has been in alfalfa or sweetclover the following practices are assumed:

Use of moldboard plow (in the spring)
Harrow, behind the plow or soon thereafter
Plant (with lister)
Harrow
Cultivate, three times
Husk from standing stalk

For corn, following corn or oats, the plowing and harrowing are replaced by double disking and a stalk cutter is used on corn land. Manure is applied in the early spring.

Assumed practices in small-grain production are as follows, where small grain follows corn and is sown alone:

Treat seed for smut
Cut corn stalks
Disk corn stalks twice
Harrow
Drill
Combine

When sweetclover is seeded with oats the seedbed is packed before it is seeded. The oats are sown at half the regular rate and are assumed to be harvested for grain. The sweetclover is plowed under the following spring between the middle of April and early May, when about 8 inches high.

With alfalfa, the following are the assumed practices:

Plow
Harrow
Disk twice
Pack
Drill
Pack
Mow
Rake
Bale from windrow
Haul and store in barn or near feed yards

There are usually three cuttings in this area. It is assumed that on the acreage pastured by hogs one cutting will be harvested.

The hog enterprise could be handled by several alternative systems each of which would have its advantages. The one-litter system assumed in the budgets is the most common in the area. It permits later farrowing in the spring than with the two-litter system and although this brings the pigs to market later than is desirable from the standpoint of highest market prices, losses from unfavorable weather at farrowing time should be somewhat less, and feed costs per pound of gain should be lower because more of the feed is furnished by alfalfa pasture.

It is assumed that pigs will be farrowed in individual hog houses on alfalfa pasture, and that gilts will be used rather than mature sows. The hog houses will be moved to the farmstead in the fall and insulated with straw to provide winter quarters for the gilts.

A self-feeder will be provided for the sow and pigs when the pigs are 2 weeks old. The pigs will be vaccinated against cholera at 4 or 5 weeks and castrated at 6 weeks. At 7 or 8 weeks the pigs will be weaned by providing a creep feeder. Automatic waterers are assumed to be used except when sows are in farrowing pens, water being hauled to the pastures in tanks.

Pigs will be "grown out" on alfalfa pasture with a full-grain ration and will be marketed at about 225 pounds, around the middle of October.

Breeding gilts will be allowed to run with other hogs during the pasture season, after which they will be grown out separately to prevent them from becoming too fat.

The beef enterprise is assumed to consist of the purchase of yearling steers weighing about 675 pounds in the fall; fattening them on corn, oats, and alfalfa hay, for 150 days. It is assumed that they will weigh 1,025 pounds when sold. Cattle will be fed grain, by hand, in feed bunks, and self-feeders will be used for hay.

The dairy and poultry enterprises are assumed to be maintained primarily for home use and as a means of utilizing family labor. Two dairy-type cows will be kept on farms of all sizes. They will be artificially bred. The poultry enterprise is assumed on all farms to consist of 200 laying hens. About 500 unsexed chicks will be bought each year for meat and replacement. Nearly all hens will be replaced each year. Home gardens are assumed on all farms.

Optimum Size of Farm for Given Combinations of Equipment

The capacity for getting work done within the number of days prescribed by nature provides an upper limit to the acreage a farmer can properly take care of with a given labor force.

With the equipment duty rates given in table 23, and the assumed cropping system and practices, it remains only to determine the approximate dates within which the principal field operations should be completed, in order to arrive at the approximate maximum acreage of cropland that can be cared for with a given line of equipment. Dates within which the major field jobs should be performed under average weather conditions are shown in table

12. These are based upon published results from the Nebraska Agricultural Experiment Station, and upon interviews with agronomists. In a year that has average weather conditions, failure to do the various field operations within the approximate periods indicated would probably result in lower yields, or lower quality in some cases. At the North Platte Station, average yields, 1909–25, of barley seeded early (average date, April 5) were 23.9 bushels per acre, compared with 14.6 bushels for late seedings, (average date, April 29). During the same period, comparable yields for early and late seedings of oats were 30.9 and 22.7 bushels respectively (*57*). Variations in date of planting corn are not so likely to cause lowered yields as to result in production of soft corn.

The suggested beginning date for the preparation of the seedbed for corn following a legume is based upon the practice of plowing under the legume when it has attained a growth of about 8 inches (*17*). The beginning date for picking corn assumes that corn will mature in this area about September 20, with 35 percent moisture, will lose about 1.5 percent of moisture a day, and is safe to store at 20-percent moisture content.

TABLE 12.—*Approximate dates, with average weather conditions, within which specified jobs should be done, northeastern Nebraska*

Crop and operation	Approximate dates	
	From —	To —
Alfalfa, new seeding:		
Preparing seedbed	Mar. 15	Mar. 31
Seeding	Apr. 1	Apr. 20
Mowing and storing nurse crop	June 20	July 15
Clip weeds, once	July 20	Aug. 30
Alfalfa, old stands:		
Cut and store	June 5	June 20
Cut and store	July 15	July 31
Cut and store	Aug. 25	Sept. 10
Oats or barley:		
Seedbed preparation	Mar. 15	Mar. 25
Drilling	Mar. 25	Apr. 5
Combining	July 10	July 25
Listed corn following alfalfa or clover[1]		
Seedbed preparation	Apr. 25	May 10
Lister-planting	May 10	May 25
Harrowing	May 25	June 5
Cultivation, three times	June 6	July 10
Picking	Oct. 1	Dec. 15

[1] For corn following corn the dates are the same except that seedbed preparation can be started earlier, about March 15 on the average.

Not all the time indicated in table 12 will be suitable for the field work. Rainfall is the principal hindrance to work in the fields. An attempt is made in table 27 to allow for its effect in estimating number of days available for field work.

Table 13 shows the approximate hours required for field work per acre of cropland, with the assumed crop rotation and rates of machine performance, and with sizes of equipment shown in table 11 for two-plow and three-plow tractors. A second source of power (a team, pick-up truck, or small tractor) is assumed to be available to permit simultaneous performance of such jobs as baling and hauling hay, combining and hauling grain, and picking and hauling corn.

According to table 13, about the maximum crop acreage that can properly be cared for with a two-plow tractor and equipment is 156 acres. There are two periods which set the limit to acreage: the first comes about the middle of June in connection with cultivation of corn and putting up the first cutting of hay and the second comes in mid-July, associated with the second cutting of hay, cultivation of corn and harvest of small grain. If only one source of power were assumed, it would be possible to care for only about 120 acres, in June.

With a three-plow tractor as the major source of power the maximum crop acreage that can be handled properly during the two middle weeks of June is 171 acres, and during the middle weeks of July, 213 acres. With sizes of equipment commonly used with the three-plow tractor, rather small savings in time are possible during the peak periods of haying, cultivating, and small-grain harvest. Much greater savings in time occur in connection with seedbed preparation and picking corn. Although it appears from table 13 that there is ample time in the spring for preparing the seedbed, the frequent occurrence of inclement weather during this season gives a considerable advantage to equipment that is large enough to get the work done on time, even in years of unfavorable weather.

TABLE 13.—*Hours required per acre for field work on corn-livestock farms, with two-plow and three-plow tractors and supplementary sources of power, and maximum acreage that can be handled, by periods*

Period	Hours per acre of cropland[1]		Hours available in average year[2]	Maximum acres that can be handled with	
	Two-plow tractor	Three-plow tractor		Two-plow tractor	Three-plow tractor
Mar. 1–10	0.069	0.060	85	1,232	1,417
11–20	.183	.157	80	437	510
21–31	.185	.151	85	459	563
Apr. 1–10	.094	.072	80	851	1,111
11–20	.040	.037	70	1,750	1,892
21–30	.199	.147	55	276	374
May 1–10	.216	.161	55	255	342
11–20	.259	.220	70	270	318
21–31	.168	.165	80	476	485
June 1–10	.314	.276	65	207	236
11–20	.353	.322	55	156	171
21–30	.293	.292	75	256	257
July 1–10	.313	.305	85	272	279
11–20	.504	.376	80	159	213
21–31	.437	.210	95	217	452
Aug. 1–10	.241	.133	70	290	526
11–20			80		
21–31	.127	.076	90	709	1,184
Sept. 1–10	.250	.117	55	220	470
11–20			75		
21–30			70		
Oct. 1–10			75		
11–20			80		
21–31	.274	.097	90	328	928
Nov. 1–10	.274	.097	90	328	928
11–20	.274	.103	75	274	728
21–30	.274	.097	85	310	876
Dec. 1–10	.274	.097	90	328	928

[1] Assuming the rotation given on p. 33 and the practices outlined on p. 34.
[2] Assuming 10-hour days with no time off except that necessitated by inclement weather.

INCOME AND SIZE OF FARM

In the preceding sections the efficient combination of the factors of production in relation to various farm jobs and enterprises is discussed. The purpose of this section is to compare income potentialities from various sizes of corn-livestock farms, organized as previously described, and to determine the productivity of labor and management on different sizes of farms in terms of net returns per hour of work.

Budgets are presented which permit a comparison of four sizes of farms which may be described as: (1) A 1-man, 2-plow tractor farm; (2) a 1-man, 3-plow tractor farm; (3) a 2-man, two-tractor farm; and (4) a large-scale farm employing five men the year round and requiring seven tractors.

All these budgets are based upon the same crop and livestock enterprises, crop rotation, and level of intensity. Size of major livestock enterprises is adjusted to utilize practically all the grain and hay produced.

Yields of crops and rates of livestock production are kept the same for all sizes of farms. Inputs of labor and material per crop acre or per head of livestock are varied only as they are affected by changes in size of enterprise, as previously discussed.

The four farm budgets may be thought of as representing individual firms operating at maximum physical output per unit of labor and equipment input. With the size of "plant" in terms of labor and equipment assumed in each case, yields per acre would go down if acreage were increased, because field work could not be completed on time. It would be interesting to learn the point at which increases in acreage would increase total unit costs, but data are inadequate for estimating the probable drop in yield that would result from a given delay in time of doing the work.

Returns from different sizes of farms are compared under average conditions of yield and during a period of drought.

For the one-man farm operated with a two-plow tractor an additional analysis is given to indicate the approximate long-run effects on costs and income of a 20-percent reduction in total acreage.

Prices and cost rates used in the budgets are averages of those reported for Nebraska from 1935 to 1939 inclusive; when estimated, they are based upon relationships prevailing during that period. These are shown in tables 28 and 29.

Crop yields are based upon average yields in Cuming County, Nebr., from 1910 to 1941, with corn yields adjusted to allow for the influence of hybrid seed (table 30).

Feed requirements for livestock as used in the budgets are shown in table 31. They are based largely upon reports of Nebraska studies that have been published.

Detailed assumptions used in the preparation of budgets are given in the Appendix.

ORGANIZATION AND EQUIPMENT FOR FOUR SIZES OF FARMS

Land use and acreages of the different crops are shown in table 14 for the four hypothetical farms. It will be noted that a shift from a two-plow to a three-plow tractor permits an increase of only 10 percent in acreage that can be taken care of properly. With two tractors, acreage can be approximately doubled. The large-scale farm is four times as large as the two-man, two-tractor, farm. It would require seven tractors, under assumed conditions of efficiency and practices, and five men the year round, with additional labor hired in the summer.

Comparative livestock numbers for the four farms are shown in table 15. Numbers of milk cows and hens, kept mainly for home use, are the same on all sizes of farms. Consequently, numbers of other classes increase somewhat more than proportionately with increasing size. Some variation in proportionality also occurs as a result of rounding numbers of head to the nearest whole number.

Values of buildings, fences, and water systems, are shown in table 16. These figures are calculated on the basis of providing comparable facilities, on different sized farms. Values shown are those used in the budget inventories; they assume the facilities to be half depreciated. It is assumed that housing accommodations for hired men are not furnished on the larger farms, one dwelling of the same size and cost being provided for each farm. A comparison is also provided of investment in buildings, except the dwelling. Even with the dwelling excluded, it appears that the larger units possess substantial economies in cost of improvements per acre, particularly with respect to fencing, the water system, and shelter for livestock.

TABLE 14.—*Land use on four sizes of corn-livestock farms, northeastern Nebraska*

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Two-man, two-tractor farm	Large-scale, seven-tractor farm
	Acres	*Acres*	*Acres*	*Acres*
Total acres	200	220	440	1,760
Farmstead and waste	10	11	22	88
Native pasture	30	33	66	264
Cropland:	160	176	352	1,408
Corn	91	101	202	804
Alfalfa for hay	17	18½	36	145
Alfalfa, hog pasture	6	6½	14	56
Oats and alfalfa (new seeding)	6	6	12	51
Oats and sweetclover	17	19	38	151
Barley	23	25	50	201

TABLE 15.—*Livestock numbers on four sizes of corn-livestock farms, northeastern Nebraska*

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Two-man, two-tractor farm	Large-scale, seven-tractor farm
	Number	*Number*	*Number*	*Number*
Cows, beef	8	9	20	90
Cows, milk	2	2	2	2
Calves	9	10	20	82
Bulls	1	1	1	2
Feeder cattle, raised	7	8	16	27
Feeder cattle, purchased	45	52	106	427
Sows	12	13	28	112
Boars	1	1	1	4
Hens	200	200	200	200

TABLE 16.—*Value of buildings and improvements on four sizes of corn-livestock farms, northeastern Nebraska* [1]

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Two-man, two-tractor farm	Large-scale, seven-tractor farm
	Dollars	*Dollars*	*Dollars*	*Dollars*
Dwelling	1,700	1,700	1,700	1,700
Feeder barn	557	593	1,008	2,255
Hog houses	132	143	308	1,232
Poultry house	467	467	467	467
Corn crib and granary	726	850	1,646	6,509
Feed yards and bunks	111	147	214	490
Garage and shop	262	262	262	524
Total buildings	3,955	4,162	5,605	13,177
Fences	315	345	460	1,665
Water system	209	209	340	1,360
Total permanent improvements	4,479	4,716	6,405	16,202
Total permanent improvements except dwelling	2,779	3,016	4,705	14,502
Total improvement investment per acre	22	21	15	9
Total improvement investment except dwelling per acre	14	14	11	8

[1] Inventory values (55 percent of 1935–39 cost, new) assume buildings half depreciated and a salvage value of 10 percent of cost new.

Items of equipment needed on the different sized farms are shown in table 17. This table also shows the total inventory value of equipment. Need for a machine was ascertained by considering the work to be done, the time available, and the amount of work that could be done in a day. In some cases excess capacity was provided in order to get work out of the way more speedily so that tractors could be freed for other work. Sizes of equipment were generally matched to the capacity of the tractor, but some consideration was given to common sizes of implements found in the area. This was particularly true for listers and shovel cultivators.

As indicated in the table, some of the more expensive machines are assumed to be jointly owned by two or three persons on the smaller farms. The decisions as to which machine should be shared, and the number of farmers who might jointly own one machine to advantage, were based upon need for timeliness in doing the work. The large-scale farm with 804 acres of corn and 201 acres of hay utilizes approximately the full capacity of one pick-up baler and one two-row corn picker.

Although horses furnished the second source of power on most corn-livestock farms, in 1944, a small one-plow tractor is assumed in the budgets. It is assumed that this machine is bought secondhand, except on the large-scale farm.

TABLE 17.—*Equipment needed, number and inventory value, on four sizes of corn-livestock farms, northeastern Nebraska*

Item	One-man, one two-plow tractor farm		One-man, one three-plow tractor farm		Two-man, two-tractor farm		Large-scale, seven-tractor farm	
	Number	*Size*	*Number*	*Size*	*Number*	*Size*	*Number*	*Size*
Plow, 14-inch bottom	1	2-bottom	1	3-bottom	2	3-bottom	4	3-bottom
Harrow, spike	1	20-foot	1	20-foot	1	24-foot	2	24-foot
Disk, single	1	15-foot	1	18-foot	1	18-foot	2	18-foot
Packer	1	15-foot	1	17-foot	1	17-foot	1	17-foot
Drill	1	10-foot	1	12-foot	1	12-foot	2	12-foot
Mower	1	7-foot	1	7-foot	1	7-foot	2	7-foot
Rake, side del.	1	12-foot	1	12-foot	1	12-foot	2	12-foot
Baler, auto pick-up	⅓		⅓		½		1	
Lister	1	2-row	1	2-row	2	2-row	5	2-row
Cultivator, shovel	1	2-row	1	2-row	2	2-row	4	2-row
Cultivator, listed corn							3	4-row
Corn picker	1	1-row	1	2-row	1	2-row	1	2-row
Stalk cutter	1	3-row	1	3-row	1	3-row	2	3-row
Grain and bale elevator	1		1		1		2	
Combine	½	5-foot	½	6-foot	1	6-foot	2	6-foot
Four-wheel trailer	2		2		2		3	
Grain box for trailer	2		2		2		3	
Manure loader	1		1		1		1	
Feed grinder	1		1		1		1	
Manure spreader	1		1		2		3	
Hay racks	2		2		2		3	
Cream separator	1		1		1		1	
Auto	1		1		1		1	
Pick-up truck							1	
Tractor	1	2-plow	1	3-plow	2	3-plow	7	3-plow
Small tractor or team	1		1		1		1	
Inventory value[1]	$3,440.00		$3,844.00		$5,542.00		$12,418.00	
Value per crop acre	21.50		21.84		15.74		8.82	

[1] Charging one-half value of car to farm business. Equipment values (at 1935–39 level) assume machinery to be half depreciated and a salvage value of 10 percent of cost new.

According to the figures in table 17 a shift from a two-plow tractor and equipment to a three-plow set-up would result in a slight increase in investment in equipment per crop acre. This results from the selection of sizes of equipment that do not always fully utilize the increased size of power unit, for reasons that were pointed out earlier. For the larger farms a considerable decrease in the investment in equipment per crop acre appears to be possible. On multiple-tractor farms several field operations can be done simultaneously, which lengthens the number of days that can be devoted to each job and increases the duty of each machine. There are several items of equipment which farmers generally do not care to own jointly with their neighbors but which have the capacity for covering a large acreage. Power mowers, disks, and harrows are examples. The numbers of these machines do not have to be increased proportionately with increases in size of farm.

Total budgeted investment for the four farms is shown in table 18.

TABLE 18.—*Investment on four sizes of corn-livestock farms, northeastern Nebraska*

[1935–39 price level]

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Two-man, two-tractor farm	Large-scale, seven-tractor farm
	Dollars	*Dollars*	*Dollars*	*Dollars*
Land[1]	14,800	16,280	32,560	130,240
Buildings and improvements	4,479	4,716	6,405	16,202
Machinery[2]	3,440	3,844	5,542	12,418
Livestock[3]	3,045	3,417	6,652	26,422
Feed and seed inventory[4]	733	876	1,758	7,064
Total investment	26,497	29,133	52,917	192,346
Total investment per acre	132	132	120	109
Total except dwelling	24,797	27,433	51,217	190,646
Total except dwelling per acre	124	125	116	108

[1] Valued at $74 per acre—the average value reported by farm-account keepers in Dakota, Dixon, Thurston, and Burt Counties, Nebr., from 1935 to 1939.

[2] From table 17.

[3] As of January 1. Half the value of feeder livestock included to allow for part of the year they are on the farm.

[4] At one-fourth value of crop not sold to allow for part of the year held.

Investment per acre is seen to be about the same for the two smaller sizes of farms and somewhat lower for the larger ones. If dwellings are excluded, the percentage decrease for the two-man farm compared with the one-man unit is about 7 percent and the investment per acre for the large-scale farm is less than for the two-man farm by the same percentage.

FARM INCOMES

Financial summaries for the four sizes of farms are shown in table 19. Three measures of farm returns are used: Operator's net labor and management earnings, return to all labor and management, and return on investment.

Operator's net labor and management earnings is a measure of the net returns to the operator for his management and labor. Return to all labor and management is the net return to the operator, family, and hired labor. When expressed as return per hour of labor this measure reflects changes in productivity of all labor and management as related to size of farm. Neither of these measures, as used in this study, should be considered to indicate

TABLE 19.—*Financial summary of four sizes of corn-livestock farms, normal yields and 1935–39 prices, northeastern Nebraska*

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Two-man, two-tractor farm	Large-scale, seven-tractor farm
	Dollars	*Dollars*	*Dollars*	*Dollars*
Income, total	7,852.00	8,859.00	17,629.00	70,544.00
Crops	39.00	36.00	186.00	1,368.00
Livestock	7,431.00	8,441.00	17,061.00	68,794.00
Livestock products	382.00	382.00	382.00	382.00
Expense, total specified	4,585.00	5,209.00	9,821.00	38,876.00
Feed	191.00	202.00	367.00	1,298.00
Crop expense, misc.	144.00	161.00	319.00	1,326.00
Livestock expense, misc.	108.00	114.00	170.00	507.00
Livestock purchased	2,524.00	2,917.00	5,946.00	23,950.00
Repairs, gas and oil	468.00	560.00	890.00	3,233.00
Depreciation	676.00	731.00	1,068.00	3,035.00
Interest on working capital[1]	56.00	65.00	125.00	487.00
Taxes	260.00	285.00	518.00	1,885.00
Miscellaneous[2]	158.00	174.00	296.00	1,016.00
Labor hired	....	....	122.00	2,139.00
Net difference	3,267.00	3,650.00	7,808.00	31,668.00
Interest on investment at 4½ percent	1,192.00	1,311.00	2,381.00	8,656.00
Value unpaid family labor	61.00	70.00	114.00	153.00
Farm perquisites	377.00	377.00	377.00	377.00
Operators' labor and management earnings[3]	2,391.00	2,646.00	5,690.00	23,236.00
Net return to all labor and management[4]	2,452.00	2,716.00	5,926.00	25,528.00
Net return on investment[5]	1,762.00	1,995.00	4,519.00	18,802.00
Operator's labor and management earnings (per acre)	11.96	12.02	12.94	13.20
Labor and management return per hour labor	.78	.85	1.28	1.77
Value of input per unit of output[6]	.90	.90	.87	.86
Total man hours labor	3,143.00	3,208.00	4,641.00	14,431.00
Rate of return on investment, pct.	6.7	6.9	8.6	9.8

[1] Assumes half of money needed for current operating expenses is borrowed for an average period of 6 months at 6 percent.

[2] Includes insurance on buildings, electricity, and telephone, plus minor items estimated at 2 percent of total operating expenses.

[3] Cash income plus perquisites, minus specified expenses, minus value of unpaid family labor and interest on investment.

[4] Cash income plus perquisites minus specified expenses except for hired labor, minus interest on investment.

[5] Cash income minus specified expenses except interest, minus value operator's labor and management and unpaid family labor.

[6] Sum of specified expenses, plus interest on investment, plus value operator's and family labor and management, divided by cash income plus perquisites.

the results that managers of average skill might expect as size of business is increased. In the budgets it is assumed that managerial capacity increases along with size of farms.

In the above calculations of returns, the value of perquisites, including rental value of the dwelling, is included in income. Cost of maintaining the dwelling is counted as an expense. Interest on all capital used in the business is included in costs.

Return on investment is a measure of net return to land and capital. Unpaid family labor is considered a cost at hired-labor rates, and value of labor and management of the operator is charged at a rate that varies proportionately with increasing size of business. For the 200-acre farm, operator's labor and management are here assumed to be worth $1,500 a year (plus perquisites). Charges for other sizes are $1,650, $3,300, and $13,200, respectively. These hypothetical figures are based on the assumption that the cost of management varies at a constant rate with size of business. This assumption is followed here in the absence of specific information about cost of management as related to size of business. The problem of increasing and decreasing costs of management is so complex that it cannot be adequately treated by the methods used in this study.

When returns from the budgeted farms, measured in these three ways, are compared, it is seen that operator's net labor and management earnings increase a little more than proportionately with increases in acreage of the farm. Per acre, earnings increase from $11.96 for the 200-acre farm to $13.20 on the large-scale unit.

Labor and management return per hour of labor increases rather rapidly with size of farm in the lower part of the size range and at a much slower rate for larger farms. The return per hour varies from $0.78 on the smallest unit to $1.77 on the largest.

Rate of return on investment increases with size of farm, but at a slower rate than return to all labor and management. This is largely because of the method of imputing value of operator's labor and management, which assumes an annual remuneration proportional with size of business. Also, productivity of labor increases more rapidly than productivity of capital because the larger farms can achieve greater economies in use of labor than in use of capital. Examination of the respective per hour and per dollar figures indicates that the rates of increase in productivity of both labor and capital do not rise rapidly beyond 440 acres, under the conditions assumed.

With increases in the assumed cost rates for labor, rates of return on capital would be reduced, and the decline would be proportionately greater on the smaller farms.

Choice of a measure of farm income depends, of course, upon the use to be made of it. In making comparisons of resource efficiency as related to size of farm, operator's return to labor and management and net return to all labor and management appear to be the most satisfactory measures. The first of these might be considered to represent the amount available under the conditions assumed, to pay to a manager of the business.

In making comparisons between farms with respect to operator's labor and management earnings, it should be kept in mind that increasing returns to the operator may result from (1) an increase in the amount of work, supervision, and managerial skill, expended by the operator, and (2) the substitution of lower paid hired labor on larger farms for the kind of work that is done by the operators on smaller farms. The significance of this income measure can be viewed in better perspective by expressing it on a per acre basis. This figure (table 19) increases only a little as size of farm increases. Therefore, if the burden of management increased in direct proportion with size of farm, the advantage to the operator from increasing the size of his business would be moderate.

It appears from the budget calculations that net returns available to operators would increase substantially as size of farm increased. Most of this increase would result from the division of net income from a given acreage among fewer operators. The large-scale farm, for example, would occupy the same area as eight 220-acre farms. The net farm income available to the operator under the assumed conditions would be $23,236 on the large farm. Each of the one-man, 220-acre farms, would have returned an income to the operator of $2,646, or a total of $21,160 for all eight of them. The moderate difference between this figure and $23,236 indicates the extent of savings that would arise from increased production efficiencies other than a reduction in number of operators.

Use of the return to all labor and management in comparisons of operating results on different sizes of farms has the advantage that it treats the human contribution as a residual and thus eliminates the effect of substitution of hired for operator's labor. Therefore, income changes that are due to a change in the method of remunerating labor are not included with those changes that result from more efficient combinations of the factors of production.

This measure indicates maximum increase in return to all labor and management that could be expected as a result of more efficient combinations of machine resources and labor, as size of farm increases. As with operator's labor and management earnings, it is necessary to keep in mind that managerial inputs go up along with increasing size of farm.

As a further comparison of productivity of farms of different sizes, the value of input per unit of output is shown in table 19. The measure of output is total cash income plus value of perquisites. Inputs consist of all annual cash expenses, including interest on total investment and on working capital; and the same charges for operator's labor and management, and unpaid family labor, that were used in calculating the return on investment.

Unit cost of production, figured in this way, is about the same for the two smaller sizes of farms and the decline in value of input per unit of output for the large-scale farm compared with the 200-acre farm is only about 5 percent. Assuming that management is a cost that varies in direct proportion with acreage of the farm, this measure reflects the possible economies of scale resulting from more efficient use of resources other than management.

EFFECT OF DROUGHT AND CHANGE IN PRICES ON FARM RETURNS

The effect of reduced yields on returns from farms of different sizes gives one indication of their relative ability to withstand periods of adversity.

For the purpose of this comparison, a period of drought is assumed, comparable in intensity to that prevailing in northeastern Nebraska from 1934 through 1939. During that period, average yields per harvested acre in Cuming County were: Corn, 17.2 bushels; oats, 23.7 bushels; barley, 21.8 bushels; and alfalfa hay, 1.7 tons. Yields used in the budgets are adjusted to allow for improved varieties of corn and oats, and to allow for lower yields of oats when they are used as a nurse crop. Assumed yields are: Corn, 20 bushels; oats (nurse crop), 18 bushels; barley, 21 bushels; alfalfa hay, 1.7 tons.

Crop acreages remain unchanged, and livestock numbers are adjusted to conform with the reduced feed supply (table 20). Because of a greater decline in the production of grain than in forage, it is necessary to buy some grain. No changes are assumed in building or equipment inventories, nor in prices paid or received. Budgeted income and expenses under drought conditions are shown in table 21.[11]

Under the assumed conditions, the smallest net farm income to the operator and the lowest return to all labor and management occur with the one-man, three-plow combination. Inspection of preceding tables will show that this farm has a higher investment in equipment per acre than the two-plow farm. Cost of tractor power per acre is also higher, total costs of tractor power being $1.95 per crop acre with the three-plow tractor and $1.46 per crop acre with a two-plow tractor. Although these costs are higher, the three-plow set-up makes a better return with normal yields because a larger volume of business is handled with the same labor force. This advantage disappears under drought conditions.

TABLE 20.—*Livestock numbers under drought conditions on corn-livestock farms, northeastern Nebraska*

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Large-scale, seven-tractor farm
Cows, beef	4	5	55
Cows, milk	2	2	2
Calves	5.4	6	50
Bulls	1	1	2
Feeder cattle, raised	4.3	5	39
Feeder cattle, purchased	27.7	29	286
Sows	7	8	70
Boars	1	1	3
Hens	200	200	200

[11] No budget was prepared for the two-man farm. The results would naturally lie somewhere between those of the one-man and large-scale farm.

TABLE 21.—*Financial summary of corn-livestock farms under drought conditions, northeastern Nebraska*

Item	One-man, one two-plow tractor farm	One-man, one three-plow tractor farm	Large-scale, seven-tractor farm
	Dollars	*Dollars*	*Dollars*
Income, total cash	4,985.00	5,319.00	45,203.00
Crops	7.00		
Livestock	4,596.00	4,937.00	44,821.00
Livestock products	382.00	382.00	382.00
Expenses, total specified	3,654.00	3,963.00	30,855.00
Feed	356.00	365.00	2,422.00
Crop expense, misc.	134.00	150.00	1,172.00
Livestock expense, misc.	86.00	89.00	347.00
Livestock purchased	1,554.00	1,627.00	16,042.00
Repairs, gas and oil	436.00	548.00	3,128.00
Depreciation	665.00	729.00	2,994.00
Interest on working capital[1]	43.00	47.00	376.00
Taxes	246.00	269.00	1,764.00
Miscellaneous[2]	134.00	139.00	776.00
Labor hired			1,834.00
Net difference	1,331.00	1,356.00	14,349.00
Interest on investment at 4½ percent	1,131.00	1,236.00	8,102.00
Farm perquisites	377.00	377.00	377.00
Operator's labor earnings[3]	516.00	427.00	6,471.00
Net return to all labor and management[4]	577.00	497.00	8,458.00
Operator's labor earnings per acre	2.58	1.94	3.68
Labor and management return per hour all labor	.20	.17	.68
Total man hours labor	2,854.00	2,896.00	12,430.00

[1] For explanatory notes, see table 19.

The large-scale farm is able to return a substantial income to the operator even with low yields. The return to labor and management per hour is substantially greater on the large-scale farm than on smaller units. The more favorable results on the large-scale farm can be explained by lower investment per acre in buildings and equipment, lower operating costs per acre, and the proportionately greater reduction in the labor required. On the smaller farms, reduced livestock numbers result in relatively small reductions in the work to be done because the total number of animals cared for is small. The large-scale farm is operating at a level where labor required is more nearly proportional with numbers cared for.

A drop in prices would also leave the large-scale operator in a more favorable position than the smaller farmer. If prices received averaged 75 percent of the 1935–39 level, and prices paid were unchanged, the operator's net labor earnings would be $499 on the one-man three-plow farm and $5,600 on the large-scale farm, assuming normal yields. Labor and management return per hour of labor would be $0.12 and $0.48 respectively.

It is sometimes held that periods of adversity favor the smaller farms. The reverse must be the case so long as investment per acre, and operating costs per acre, are lower on the larger farms, and yields and rates of production are the same on all sizes. Even if conditions were so bad that losses were incurred, the smaller farms would be the first to show a loss. In severe depressions, when even the most efficient farms are losing money, the larger operator is in a position to lose the greatest amount; and unless his reserves are substantial, he might be put out of business ahead of some of his smaller and less efficient competitors. Also, the fact that cash costs are a smaller proportion of the total on small farms strengthens their position in hard times.

A higher rate of interest than is assumed in the budgets would result in a relatively greater decrease in net income on the smaller farms because the amount of capital used per acre decreases with increasing size. A higher wage rate would have the opposite effect as labor is not a cash cost on the smaller farms. Operator's net labor earnings would become relatively more favorable on the smaller farms as wage rates went up.

Costs and Returns on a 160-Acre Farm

This study has been primarily concerned with the comparative efficiency in use of resources between four sizes of farms. Each of these budgeted farms is intended to represent the combination of resources that should give lowest unit costs of production for that particular size of farm, under the conditions assumed. In other words, these budgets have been constructed for the purpose of examining the comparative efficiency of different sizes of farms when each size represents as good a combination of resources as can be planned for that size of unit.

This is only one aspect of the broader problem of optimum sizes of farms. Another important problem is related to the extent to which net returns would be different on farms a little larger or smaller than the "optimum-size" farms discussed here. A complete examination of all the pertinent resource combinations would be a study in itself; data are presented here for only one situation —a 160-acre farm with the same crop and livestock organization as assumed in preceding budgets. Although this farm is 20 percent smaller than the 200-acre farm previously budgeted, it required the same size of tractor, and about the same crop equipment as the larger farms. This budget indicates the effect on costs of operating a farm smaller than can be cared for with a given line of equipment.

This farm would have 128 acres of cropland and the same crop-rotation and livestock system as previously described. The investment in land and livestock, and the feed and seed inventory would be 20 percent lower than on a 200-acre farm. The machinery inventory could be reduced about 9 percent and the building inventory by 5 percent.

The total investment would be $22,300; with $12,400 in land; $3,800 in buildings; $2,400 in livestock; $3,100 in machinery; and $600 in feed, seed and supplies. Gross farm income including perquisites would be about $6,580; cash farm expenses, $3,779; operator's net labor earnings, $1,778; and return to labor per hour $0.63.

These figures indicate a considerably sharper rate of decline in earnings with decreasing size of farm than is shown by a comparison of optimum-size two-plow and three-plow tractor farms. This suggests that achieving an efficient combination of resources probably would have a greater influence on farm returns than would result from a shift from one optimum size unit to a larger one.

Significance of Comparisons of Income

What practical conclusions can be drawn from the income figures presented in this section, and what limitations should be placed upon such conclusions?

In the first place, it appears that for corn-livestock farms, the possibility of increasing efficiency by expanding the size of business is not large except as related to a reduction in the number of farm operators. This conclusion is based upon comparisons between carefully planned farm units. It is probable that greater economies might be made by reorganizing existing farming systems and improving farm practices with relatively little adjustment in farm acreage.

The principal source of increased income would result from a decrease in number of operators. Therefore, the extent that such increases in income could be realized would depend upon the ability of farm operators to expand their operations without impairing their production efficiency. There would be a further question as to whether managers of this degree of competence would consider the increased returns as adequate remuneration for their effort. These questions are beyond the scope of this study.

Conclusions with respect to desirable sizes of farms should not be based merely upon comparative production efficiency. They should also take into account the question of the social desirability of an agriculture organized around relatively few large-scale farms that return fairly high incomes to the operators, as compared with a larger number of medium-sized units yielding moderate incomes. Again the advantages of maintaining an array of sizes to match the capacities of family labor and managerial resources should not be overlooked.

CONCLUSIONS

Most of the economic comparisons that have been made between sizes of farms do not distinguish clearly between results that are directly related to variations in size, and other variations associated with it. This difficulty, to a considerable extent, is inherent in the use of survey or farm-account data.

The approach used in this study is one of developing hypothetical budgets in which only those inputs and outputs are allowed to vary for which it is reasonable to expect variation with changes in size of farm. This is a planning or engineering approach, and requires detailed knowledge of the nature of the farm business and of the enterprises involved. The procedure is not suitable for comparisons of historical results on actual groups of farms, but is superior for analyses of desirable combinations of resources, particularly if the purpose is to compare sizes of farms.

The scope of this study is limited to a comparison of efficiency in use of resources between four sizes of farms. Each of these is intended to represent as good a combination of resources as can be planned for that particular size of unit. Thus it is an examination of possible rather than attained resource efficiency between farms that cover a medium size range from 200 to 1,760 acres. The problem of existing resource maladjustments arising from less efficient resource combinations is only briefly examined. The important question of production inefficiencies on small farms is not covered, although this research does furnish a basis for developing standards that would be helpful in evaluating the extent of resource maladjustment on small units.

The area studied is the corn-livestock area of northeastern Nebraska. In this area sizes of farm implements are not closely related to size of farm, nor is size of implement closely correlated with size of tractor. The average number of horsepower available per crop acre declines as size of farm increases, but there is wide variation between farms, arising from a variety of causes.

Size of labor force reported on these farms is not closely related to size of business. In this area, workers on two- and three-man farms accomplished less work per man than workers on either one- or four-man units, apparently as a result of less than full utilization of family labor.

The observation is often made that most farm jobs can be more efficiently done with a crew of two men or more; but a job analysis of selected enterprises indicates that out of 45 operational jobs analyzed, all but 4 can be efficiently handled by one man or by a man and a boy.

From the standpoint of reasonably efficient utilization of machinery and equipment, a corn-livestock farm in this area should have a minimum of about 200 acres. This farm could be operated with a two-plow tractor and would utilize the time of one man, with incidental family help. With a three-plow tractor the farm should have about 220 acres. An efficient two-man, two-tractor farm should have about 440 acres.

Per acre investment in machinery and machine-operating costs per acre decline with increasing size of farm in this area. Although the rate of decline in costs is high with smaller acreages, a full-sized family-operated farm is large enough to permit reasonably efficient utilization of equipment. Decreases in machinery costs per acre become relatively insignificant for corn-livestock farms larger than a two-man unit.

Under the conditions assumed in this study, returns to labor and management per hour could be expected to be considerably greater on a carefully planned two-man, two-tractor unit of 440 acres than on an equally well-organized one-man, one-tractor farm of 200 acres. Further increases in size of farm would give still larger returns per hour, but the increase would be at a much lower rate.

These increases could be expected only if managerial skill increased in proportion with size of farm. Therefore, they do not reflect the returns that managers of *average* capacity might expect from an increase in size of business.

These increases in hypothetical returns from labor and management result principally from the reduction in number of farm operators. Increased returns arising from more productive use of buildings, machinery, and equipment, are rather small. If management were considered to be a cost that increased directly with size of business, estimated unit costs of production would be only 5 percent lower on a 1,760 acre farm than on a comparable 200-acre unit.

Under conditions of drought or low prices, declines in net returns can be expected to be greater on small than on large farms so long as investment per acre, and operating costs per acre, are lower on the larger farms. However, a smaller proportion of total costs must be met with cash on small farms.

It seems probable that, with respect to corn-livestock farms, savings that could be made in costs of production by expanding the size of farm might not be so large as the possible reductions in cost on moderate-sized units from reorganizing existing farming systems and practices. This question is only briefly considered in this bulletin.

LITERATURE CITED

(1) AGRICULTURAL ENGINEERING.
1945. THE TWO FAMILY FARM. Editorial. Agr. Engin. 26 (5): 185.

(2) ANDERSON, A. W.
1940. EFFICIENCY OF FIELD OPERATION AS AFFECTED BY THE SIZE OF FIELD. Minn. Univ. Farm Business Notes, Oct., pp. 2–3.

(3) BLACK, J. D., and BLACK, A. G.
1929. PRODUCTION ORGANIZATION. 646 pp., illus. New York.

(4) BRACKETT, E. E., and LEWIS, E. B.
1934. USE OF ELECTRICITY ON NEBRASKA FARMS, 1920–34. Nebr. Agr. Expt. Sta. Bul. 289, 47 pp. illus.

(5) BURDICK, R. T., and PINGREY, H. B.
1932. PROFITS FROM WINTER FEEDING IN NORTHERN COLORADO. Colo. Agr. Expt. Sta. Bul. 394, 75 pp. illus.

(6) CASE, H. C. M., and ROSS, R. C.
1927. THE PLACE OF HOG PRODUCTION IN CORN BELT FARMING. Ill. Agr. Expt. Sta. Bul. 301: 147–179, illus.

(7) ———, WILCOX, R. H., and BERG, H. A.
1929. ORGANIZING THE CORN BELT FARM FOR PROFITABLE PRODUCTION, BASED ON STUDIES OF FARMS IN EAST-CENTRAL ILLINOIS. Ill. Agr. Expt. Sta. Bul. 329: 259–332, illus.

(8) CHAMBERLIN, EDWARD H.
1938. THE THEORY OF MONOPOLISTIC COMPETITION; A REORIENTATION OF THE THEORY OF VALUE. 241 pp., illus. Cambridge.

(9) CONNOR, M. C., HENDRIX, W. E., SAYRE, C. R. and FULLILOVE, W. T.
1942. FARM ADJUSTMENT OPPORTUNITIES IN GREENE COUNTY, GEORGIA. Ga. Agr. Expt. Sta. Bul. 221, 74 pp., illus.

(10) DOLL, R. J., and others.
1941. METHODS AND PRACTICES USED IN PRODUCING BEEF CATTLE IN CHASE AND LYON COUNTIES. Kans. Agr. Expt. Sta. Agr. Econ. Rept. 10, 13 pp. (Processed).

(11) DUCOFF, L. J., and HAGOOD, M. J.
1944. DIFFERENTIALS IN PRODUCTIVITY AND IN FARM INCOME OF AGRICULTURAL WORKERS BY SIZE OF ENTERPRISE AND BY REGIONS. Bur. Agr. Econ., 54 pp., illus. (Processed).

(12) ENGENE, S. A., and ANDERSON, A. W.
1947. EFFECT OF AN EROSION CONTROL PROGRAM ON LABOR AND POWER REQUIREMENTS. Minn. Agr. Expt. Sta. Bul. 396, 15 pp., illus.
(13) FENTON, E. C., and BARGER, E. L.
1945. THE COST OF USING FARM MACHINERY. Kans. Engin. Expt. Sta. Bul. 45, 56 pp., illus.
(14) FILLEY, H. S.
1934. EFFECTS OF INFLATION AND DEFLATION UPON NEBRASKA AGRICULTURE, 1914-32. Nebr. Agr. Expt. Sta. Res. Bul. 71, 16 pp.
(15) FISKE, C. A.
1945. MECHANIZATION IN NORTHEASTERN NEBRASKA, STATUS IN 1944 AND POST-WAR PROSPECTS. 26 pp., illus. Bur. Agr. Econ. Lincoln, Nebr. (Processed).
(16) GAREY, L. F.
1937. SYSTEMS OF FARMING AND POSSIBLE ALTERNATIVES IN NEBRASKA. Nebr. Agr. Expt. Sta. Bul. 309, 50 pp., illus.
(17) GARVER, S., SLATENSEK, J. M., and KIESSELBACH, T. A.
1943. SWEET CLOVER IN NEBRASKA. Nebr. Agr. Expt. Sta. Bul. 352, 47 pp., illus.
(18) GRIMES, W. E., KIFER, R. S., and HODGES, J. A.
1928. THE EFFECT OF THE COMBINED HARVESTER-THRESHER ON FARM ORGANIZATION IN SOUTHWESTERN KANSAS AND NORTHWESTERN OKLAHOMA. Kans. Agr. Expt. Sta. Cir. 142, 24 pp., illus.
(19) HAMPSON, C. M., and CHRISTOPHERSEN, POUL
1934. ESTIMATED RETURNS FROM FARMS OF LARGE, MEDIUM AND SMALL SIZE OF BUSINESS IN THE SPRING WHEAT AREA OF SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. Cir. 20, 23 pp., illus.
(20) HEADY, EARL O.
1946. PRODUCTION FUNCTIONS FROM A RANDOM SAMPLE OF FARMS. Jour. Farm Econ. 28(4): 989–1004.
(21) ———, HOPKINS, JOHN A., and MCKIBBEN, EUGENE G.
1943. COST DISTRIBUTION AND UTILIZATION OF FARM MACHINERY IN IOWA. Iowa Agr. Expt. Sta. Res. Bul. 323, 61–104 pp., illus.
(22) HOPKINS, JOHN A., JR.
1932. AN ECONOMIC STUDY OF THE HOG ENTERPRISE. Iowa Agr. Expt. Sta. Bul. 294: 157–188, illus.
(23) ———, and KIFER, R. S.
1930. THE LIVESTOCK SYSTEM IN IOWA COUNTY. Iowa Agr. Expt. Sta. Bul. 270: 208–236, illus.
(24) KALDOR, N.
1934. THE EQUILIBRIUM OF THE FIRM. Econ. Jour., 44: 65.
(25) LEE, J. K.
1946. ECONOMIES OF SCALE OF FARMING IN THE SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA. 185 pp., illus., Bur. Agr. Econ. (Processed.)
(26) LOEFFEL, W. J.
A MANUAL FOR HOG RAISERS. Nebr. Agr. Expt. Sta. Cir. 40, rev.
(27) MCKIBBEN, E. G.
1930. SOME FUNDAMENTAL FACTORS DETERMINING THE EFFECTIVE CAPACITY OF FIELD MACHINES. Amer. Soc. Agr. Engin. Jour., 11 (2): 55–57.
(28) MANN, L. B.
1936. WESTERN CATTLE AND SHEEP AREAS. U. S. Farm Credit Admin. Cir. C–103, 101 pp., illus.
(29) MARSHALL, ALFRED
1920. PRINCIPLES OF ECONOMICS. Ed. 8, 871 pp., illus. New York.
(30) MILLER, FRANK and RUDEN, W. L.
1944. COST OF OPERATING MACHINERY ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 366, 30 pp., illus.
(31) ———, ———, and SMITH, C. W.
1939. COST OF TRACTOR POWER ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 324, 18 pp., illus.
(32) MILLER, T. A. H.
1937. USE OF CONCRETE ON THE FARM. U. S. Dept. Agr. Farmer's Bul. 1772, 62 pp., illus.

(33) MYERS, W. I.
1920. AN ECONOMIC STUDY OF FARM LAYOUT. N. Y. (Cornell) Agr. Expt. Sta. Memoir 34: 385–563, illus.
(34) NEBRASKA AGRICULTURAL EXPERIMENT STATION.
1942. THE NEBRASKA TRACTOR TESTS. Nebr. Agr. Expt. Sta. Bul. 338, 52 pp.
(35) NEBRASKA STATE BOARD OF AGRICULTURE.
1910–41. NEBRASKA AGRICULTURAL STATISTICS, ANNUAL REPORTS, 1910–41. Lincoln.
(36) NEBRASKA AGRICULTURAL EXTENSION SERVICE.
n.d. PLANNING THE FARM AND HOME. 46 pp. (Processed.)
(37) PASCHAL, J. L., NELSON, A. G., and ROGENESS, OLAV.
1940. PLANNING MINIMUM SIZED FARMS FOR THE BEADLE COUNTY AREA IN CENTRAL SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. Bul. 341, 63 pp., illus.
(38) PINCHES, HAROLD E.
1944. INTEGRATING FARM MACHINERY WITH THE TRACTOR. Agr. Engin. 25(5): 173.
(39) RAWLINGS, B. R., JR., and JOHNSON, O. R.
1939. RELATIONSHIP OF PRODUCTIVITY OF FARM UNITS AND THEIR ABILITY TO PAY RENT. Mo. Agr. Expt. Sta. Res. Bul. 308, 43 pp., illus.
(40) RUSH, D. R., and LARSON, O. F.
1942. FARM RESOURCES AND FARMING SYSTEMS NEEDED TO MEET LIVING NEEDS OF FARM FAMILIES. Part I, 16 pp., illus. Bur. Agr. Econ. (Processed.)
(41) SCHULTZ, T. W.
1947. THE PUBLIC LANDS AND NATIONAL ECONOMY (IN SYMPOSIUM ON THE PUBLIC LANDS.) 22 pp. Univ. of N. Mex. Albuquerque.
(42) SCOVILLE, O. J.
1949. FIXED AND VARIABLE ELEMENTS IN THE CALCULATION OF MACHINE DEPRECIATION. U. S. Bur. Agr. Econ. Agr. Econ. Research. 1 (3): 69–77.
(43) ———
1949. SYNTHESIS OF LABOR INPUTS FOR HOGS FROM TIME-STUDY DATA. Jour. Farm Econ. 31: 549–555.
(44) SCUDDER, H. D., BURRIER, A. S., LUNN, A. G., and KNOWLTON, F. D.
1931. COST AND EFFICIENCY IN COMMERCIAL EGG PRODUCTION IN OREGON. Oreg. Agr. Expt. Sta. Bul. 287, 79 pp., illus.
(45) SHULTIS, ARTHUR.
1940. DAIRY MANAGEMENT IN CALIFORNIA. Calif. Agr. Expt. Sta. Bul. 640, 94 pp., illus.
(46) SITLER, H. G. and FISKE, C. A.
1945. HAY HARVESTING METHODS, SOUTHEASTERN NEBRASKA. Bur. Agr. Econ. 15 pp. (Processed.)
(47) SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION.
1946. BEEF CATTLE HOUSING IN THE NORTH CENTRAL REGION OF THE UNITED STATES. (North Central regional publication No. 6.) S. Dak. Agr. Expt. Sta. Bul. 382, 19 pp., illus.
(48) STARCH, E. A.
1933. FARM ORGANIZATION AS AFFECTED BY MECHANIZATION. Mont. Agr. Expt. Sta. Bul. 278, 102 pp., illus.
(49) THALMAN, R. R.
1942. WINTERING RATIONS FOR CATTLE. Nebr. Agr. Expt. Sta. Bul. 343, 44 pp.
(50) ———
1932. THE CONTRACT FEEDING OF LIVESTOCK. Nebr. Agr. Expt. Sta. Bul. 274, 44 pp., illus.
(51) UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS.
1940. FARMER'S EXPENDITURES FOR OPERATING AUTOMOBILES, UNITED STATES. INCOME PARITY FOR AGRICULTURE II, SEC. 4. 74 pp. Washington, D. C. (Processed.)
(52) ———
1943. FARM WAGE RATES, FARM EMPLOYMENT, AND RELATED DATA. 193 pp. (Processed.)

(53) UNITED STATES BUREAU OF RECLAMATION.
1946. FARM SIZE AND ADJUSTMENT TO TOPOGRAPHY, COLUMBIA BASIN JOINT INVESTIGATIONS. PROBLEMS 6 AND 8. 115 pp., illus.

(54) ———
1945. TYPES OF FARMING, COLUMBIA BASIN JOINT INVESTIGATIONS. PROBLEM 2. 342 pp., illus.

(55) UNITED STATES DEPARTMENT OF AGRICULTURE.
1946. AGRICULTURAL STATISTICS. 739 pp. Washington, D. C.

(56) VENSTROM, CRUZ and HEADLEY, F. B.
1932. FACTORS AFFECTING THE COST OF DAIRYING IN WESTERN NEVADA. Nev. Agr. Expt. Sta. Bul. 128, 28 pp., illus.

(57) ZOOK, L. L.
1926. SPRING GRAINS, TIME OF SEEDING AND COMPARATIVE YIELDS. Nebr. Agr. Expt. Sta. Bul. 213, 12 pp., illus.

APPENDIX

MISCELLANEOUS TABLES

TABLE 22.—*Number and percentage of farms reporting specified enterprises by size of farm, Cuming County, Nebr., 1942*

Enterprise	Farms reporting, by size of farms in acres													
	Less than 100		100–139		140–179		180–259		260–379		380 and over		All farms	
	No.	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
Corn	13	100	10	100	41	100	27	100	14	100	6	100	111	100
Oats and barley	10	77	9	90	41	100	26	96	13	93	6	100	105	95
Feeder cattle	10	77	9	90	25	61	22	81	13	93	4	67	83	75
Sows	9	69	9	90	38	93	25	93	11	79	4	67	93	84
Feeder cattle and sows	7	54	8	80	25	61	21	78	11	79	3	50	75	68
Neither feeder cattle nor sows	1	8	0	0	2	5	1	4	1	7	1	17	6	5
Milk cows	13	100	10	100	41	100	27	100	13	93	6	100	110	99
Poultry	13	100	10	100	40	98	27	100	13	93	5	83	108	97
Total farms in sample	13	100	10	100	41	100	27	100	14	100	6	100	111	100

TABLE 23.—*Estimated machine hours per acre by size of machine, northeastern Nebraska*

Implement	Size	Estimated hours per acre[1]	Assumed	
			Tractor dbhp	Size crew
Plow, moldboard	1–16-inch	2.40	12–15	1
Do	2–14-inch	1.50	16–20	1
Do	3–14-inch	.97	21–30	1
Disk, single	10-foot	.38	12–15	1
Do	15-foot	.24	16–20	1
Do	18-foot	.20	21–30	1
Lister	2-row	.60	[2]16–20	1
Do	3-row	.42	21–30	1
Do	4-row	.30	26–30	1
Cultivator, listed corn	2-row	.60	12–30	1
Do	3-row	.46	21–30	1
Do	4-row	.30	21–30	1
Drill	8-foot	.53	12–15	1
Do	10-foot	.40	16–20	1
Do	12-foot	.34	21–30	1
Mower	7-foot	.52	12–30	1
Side delivery rake	12-foot	.48	12–30	1
Combine	4-foot	1.20	12–15	1
Do	5-foot	.86	16–20	1
Do	6-foot	.76	21–30	1
Roller and packer	10-foot	.40	12–15	1
Do	15-foot	.29	16–20	1
Do	18-foot	.23	21–30	1
Harrow, spike	16-foot	.26	12–15	1
Do	20-foot	.23	16–20	1
Do	24-foot	.20	21–30	1
Stalk cutter	3-row	.26	12–30	1
Corn picker	1-row	1.50	16–20	1
Do	2-row	.86	21–30	1
Pick-up baler	Automatic	[3] .48	16–30	1
Hauling and stacking bales		[3] .48		3
Elevating corn, wagon to crib, 20-foot including elevator, wagon lift[4]		.12		1
Elevating corn, wagon to crib, inside cup elevator, wagon lift[4]		.06		1
Spreading manure, 1 spreader, hand load, hours, per T.[5]		.64		2
Do		1.03		1
Spreading manure, 1 spreader, and loader, hours, per T.[5]		.40		1
Spreading manure, 2 spreaders, and loader, hours, per T.[5]		.25		2

[1] Data derived from various sources including Nebr. Agr. Expt. Sta. Buls. 289 (*4*), 324 (*31*) and 366 (*30*).
[2] With 12–15 dbhp tractor assume 0.70 hour; with 21–30 dbhp, 0.53 hour.
[3] Per cutting, assuming 1 ton per acre.
[4] Hours per 50-bushel load. Nebr. Agr. Expt. Sta. Bul. 289 (*5*) and miscellaneous sources.
[5] Estimated assuming one load equals 1½ tons manure.

TABLE 24.—*Approximate cost new, years of life, depreciation, and repairs of farm equipment, northeastern Nebraska, 1935–39* [1]

Item	Cost new	Extent of life	Annual depreciation		Annual repair	
			Percentage of new cost	Amount	Percentage of new cost	Amount
	Dollars	*Years*	*Percent*	*Dollars*	*Percent*	*Dollars*
Tractor, 11–15 dbhp on rubber	700	13	6.9	48.30	(2)	----------
Tractor, 16–20 dbhp on rubber	1,100	13	6.9	75.90	(2)	----------
Tractor, 21–25 dbhp on rubber	1,300	13	6.9	89.70	(2)	----------
Plow, 1–16-inch bottom, power lift	90	16	5.6	5.04	3.0	2.70
Plow, 2–14-inch bottom, power lift	110	16	5.6	6.16	3.0	3.30
Plow, 3–14-inch bottom, power lift	165	16	5.6	9.24	3.0	4.95
Disk, single, 18-inch disks:						
10-foot with scraper	90	18	5.0	4.50	1.5	1.35
15-foot with scraper	155	18	5.0	7.75	1.5	2.32
16-foot with scraper	175	18	5.0	8.75	1.5	2.62
Corn planter, 2-row	100	18	5.0	5.00	1.0	1.00
Corn planter, 4-row	215	18	5.0	10.75	1.0	2.15
Lister, 2-row	138	15	6.0	8.28	1.0	1.38
Cultivator, 2-row	115	18	5.0	5.75	1.7	2.16
Cultivator, 2-row fert. attachment	50	18	5.0	2.50	1.7	.85
Cultivator, 4-row	250	18	5.0	12.50	1.7	3.85
Cultivator, 4-row fert. attachment	100	18	5.0	5.00	1.7	1.70
Drills with alfalfa attachment:						
8-foot power lift	235	22	4.1	9.64	.3	.70
10-foot power lift	270	22	4.1	11.07	.3	.81
12-foot power lift	310	22	4.1	12.71	.3	.93
Mower, 7-foot cut, light	110	18	5.0	5.50	2.0	2.20
Mower, 7-foot cut, heavy	145	18	5.0	7.25	2.0	2.90
Side delivery rake, on steel	130	21	4.3	5.59	1.5	1.95
Pick-up baler, automatic	1,460	10	9.0	131.40	(2)	----------
Combine, with grain tank, 4-foot	490	10	9.0	44.10	1.7	8.33
Combine, with grain tank, 5-foot	600	10	9.0	54.00	1.7	10.20
Combine, with grain tank, 6-foot	780	10	9.0	70.20	1.7	13.26
Corn picker, 1-row	485	12	7.5	36.38	1.7	8.24
Corn picker, 2-row	770	12	7.5	57.75	1.7	13.09
Manure spreader on rubber, 1 T.	130	19	4.7	6.11	.5	.65
Manure spreader on rubber, 1½ T.	205	19	4.7	9.64	.5	1.02
Tractor-drawn truck on rubber	125	18	5.0	6.25	.8	1.00

TABLE 24.—*Approximate cost new, years of life, depreciation, and repairs of farm equipment, northeastern Nebraska, 1935–39* [1]—Continued

Item	Cost new	Extent of life	Annual depreciation		Annual repair	
			Percentage of new cost	Amount	Percentage of new cost	Amount
	Dollars	*Years*	*Percent*	*Dollars*	*Percent*	*Dollars*
Wagon bed, combination	175	18	5.0	8.75	0.6	1.05
Power loader	260	12	7.5	19.50	1.5	3.90
Harrow, spike, including drawbar:						
1-section, 5-foot	15	22	4.1	.62	.3	.04
2-section, 10-foot	40	22	4.1	1.64	.3	.12
3-section, 15-foot	60	22	4.1	2.46	.3	.18
4-section, 20-foot	80	22	4.1	3.28	.3	.24
Single unit milker, with motor	190	15	6.0	11.40	7.0	13.30
Double unit milker, with motor	205	15	6.0	12.30	7.0	14.35
Cream separator, 500 pounds, electric	150	17	5.3	7.95	.7	1.05
Cream separator, table, electric	80	17	5.3	4.24	.7	.56
Packer, 9-foot	70	22	4.1	2.87	.6	.42
Packer, 15-foot	90	22	4.1	3.69	.6	.54
Packer, 17-foot	110	22	4.1	4.51	.6	.66
Packer, 19-foot	130	22	4.1	5.33	.6	.78
Stalk cutter, 3-row	85	22	4.1	3.48	1.0	.85
Truck, 1½ ton	1,200	13	6.9	82.80	(2)	----------
Corn and bale elevator	325	25	3.6	11.70	1.5	4.88
Grain elevator	275	25	3.6	9.90	1.5	4.12
Hay chopper[3]	525	10	9.0	47.25	----------	(4)
Blower[3]	200	10	9.0	18.00	.5	.90
Auto (farm share, total $1,200)	600	10	9.0	54.00	(2)	----------
Truck, pick-up ¾ ton	800	13	6.9	55.00	(2)	----------
Hay rack (farm made)[3]	25	12	7.5	1.88	.7	.18
Grinder, hammer, 60 bushels per hour	140	16	5.6	7.88	9.0	12.60

[1] Equipment costs new estimated principally on basis of 1946 prices at Lincoln, Nebr., adjusted to 1935–39 level. Years of life and repair cost estimated on basis of data contained in Iowa Research Bul. 323, (*21*), Kansas Agr. Expt. Sta. Bul. 45, (*13*), Nebraska Agr. Expt. Sta. Bul. 366 (*30*), et al. Depreciation cost assumes 10 percent of new value remaining at end of life of machine.
[2] See data on costs per hour of use.
[3] Based largely on Hay Harvesting Methods (*46*).
[4] Reported in above study at $0.15 per ton.

TABLE 25.—*Variable costs per hour for wheel-type tractors used 400–499 hours per year, northeastern Nebraska* [1]

Drawbar horsepower		Cost per hour			All variable costs	
		Fuel[2]	Grease and oil	Repairs	Per hour[3]	Per dbhp hour
Range	*Average*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
6–10	9.45	12.3	3.8	3.8	19.9	2.11
11–20	16.63	16.1	3.3	1.7	21.1	1.27
21–25	23.21	21.4	4.6	2.3	28.3	1.21
26–30	26.85	24.0	5.4	2.7	32.1	1.20

[1] Adapted from Nebr. Agr. Expt. Sta. Bul. 324 (*31, table 10*). Data based upon records kept by farmers during a 12-month period beginning in the fall of 1937.

[2] At $0.09 per gallon.

[3] Hourly costs for one-plow tractors are estimated to be $0.20; for two-plow tractors, $0.23; and for three-plow tractors, $0.32.

TABLE 26.—*Estimated annual operating costs for specified machines, northeastern Nebraska, 1935–39*

Machine	Unit	Annual cost per unit
		Dollars
Corn pickers[1]	Acres	0.11
Combines without motor[1]	do	.10
Pickup hay baler-self-tying[2]	do	.27
Automobile or light pickup truck[3]	Miles	.02¼

[1] Estimated from data in Nebr. Agr. Expt. Sta. Bul. 366 (*30*).

[2] Estimated on basis of unpublished data from the Utah Agr. Expt. Sta. and other sources. Does not include cost of bale ties which cost about 1 cent a bale or 25 cents a ton.

[3] Based on data from U. S. Bureau of Agricultural Economics (*51*).

TABLE 27.—*Average days available for field work, by periods, northeastern Nebraska*

Period	Total days in period	Average precipitation inches[1]	Average days available for field work[2]
Jan. 1–10	10	0.41	8.5
11–20	10	.26	9.0
21–31	11	.26	10.0
Feb. 1–10	10	.27	9.0
11–20	10	.25	9.0
21–28	8	.36	6.5
Mar. 1–10	10	.39	8.5
11–20	10	.46	8.0
21–31	11	.67	8.5
Apr. 1–10	10	.63	8.0
11–20	10	.95	7.0
21–30	10	1.42	5.5
May 1–10	10	1.64	5.5
11–20	10	1.11	7.0
21–31	11	1.18	8.0
June 1–10	10	1.78	6.5
11–20	10	2.24	5.5
21–30	10	1.24	7.5
July 1–10	10	.98	8.5
11–20	10	1.18	8.0
21–31	11	1.02	9.5
Aug. 1–10	10	1.38	7.0
11–20	10	1.12	8.0
21–31	11	.95	9.0
Sept. 1–10	10	1.58	5.5
11–20	10	.90	7.5
21–30	10	1.14	7.0
Oct. 1–10	10	.59	7.5
11–20	10	.53	8.0
21–31	11	.54	9.0
Nov. 1–10	10	.31	9.0
11–20	10	.57	7.5
21–30	10	.39	8.5
Dec. 1–10	10	.28	9.0
11–20	10	.24	9.0
21–31	11	.42	9.5
Total	365	29.66	284.5

[1] Summarized from daily weather records at West Point, Nebr., 1920–46 inclusive, with 1928, 1933, 1939, and 1943 omitted.

[2] Assuming 0.6-inch precipitation results in loss of one work day in July and adjusting time lost in other months in inverse proportion to changes in the rate of evaporation.

TABLE 28.—*Farm prices in Nebraska, selected periods*

Commodity	Unit	Average 1910–14[1]	Average 1923–42[2]	Average 1935–39[3]
		Dollars	*Dollars*	*Dollars*
Corn	Bushel	0.55	0.64	0.65
Wheat, all	do	.81	.88	.84
Oats	do	.36	.35	.31
Barley	do		.46	.46
Alfalfa hay (loose)	Ton		9.97	8.65
Clover and timothy hay	do			8.30
Wild hay	do		7.10	5.19
Alfalfa seed	Pound		.18	.19
Sweet clover seed	do			.06
Hogs, all	Hundredweight	7.15		[2] 8.23
Butcher hogs, 200–220 pounds	do		[4] 8.53	[4] 8.93
Butcher hogs, 290–350 pounds	do		[4] 8.27	[4] 8.55
Packing sows, 350–425 pounds	do		[4] 7.59	[4] 7.93
Beef cattle, all	do			7.34
Fat steers, good-choice	do		[4] 11.32	[4] 11.20
Fat steers, common-medium	do		[4] 8.50	[4] 8.19
Vealers, choice	do		[4] 9.02	[4] 8.63
Veal calves	do			7.56
Feeder steers, good choice	do		[4] 8.13	[4] 8.11
Feeder steers, common	do		[4] 6.19	[4] 6.19
Cows cull, 1,100 pounds	do			[4] 5.90
Sheep, all	do			4.16
Lambs, all	do			8.54
Fat lambs, choice	do		[4] 10.63	[4] 9.25
Feeder lambs	do		[4] 9.70	[4] 8.12
Milk cows	Head	40.80		52.38
Butterfat, all	Pound	.23	.30	.26
Milk, wholesale	Hundredweight			1.69
Chickens	Pound		.14	.13
Eggs	Dozen	.19	.20	.17

[1] Computed from Nebr. Agr. Expt. Sta. Res. Bul. 71 (*14*).
[2] Department Rural Economics, Univ. of Nebr., unpublished data.
[3] Estimates, Bureau of Agricultural Economics, except as noted.
[4] Omaha prices, unpublished data, Department Rural Economics, Univ. of Nebr. In budgeting, prices of animals sold are reduced $0.40 per hundredweight for freight and handling costs. Prices of feeders purchased are increased $0.20 per hundredweight to allow for freight.

TABLE 29.—*Prices paid by farmers for goods and services used in production, 1935–39*

Item	Unit	Cost
		Dollars
Building materials and fencing (United States average):[1]		
2 by 4 inches, 16-feet, fir and pine	M board feet	43.70
Boards, rough	do	42.80
Shiplap, pine	do	40.60
Siding, drop, pine and fir	do	57.80
Flooring, yellow pine	do	70.70
Windows, barn, 4-light (9 by 12 inches)	Each	1.13
Doors, Nos. 1 and 2, combined	do	4.27
Shingles	Square	5.19
Roofing, composition	do	2.37
Roofing, steel, galvanized	do	5.07
Cement, Portland	94-pound bag	.76
Nails, 8d	100 pounds	5.28
Paint, mixed	Gallon	2.92
Laths, 48-inch	Bunch of 50	.46
Wire screen, 12-mesh, 30 inches	100 feet	7.50
Brick, common	1,000	21.40
Mineral fill insulation[2]	100 square feet	3.50
Building paper[2]	Roll 500 square feet	1.25
Sand and gravel[2]	Cubic yard	1.00
Lag screws, 5-inch[2]	100	1.40
Hinges, 12-inch[2]	Pair	.50
Barn door track sets[2]	Each	5.00
Barn and garage doors[2]	do	3.50
Fence posts, steel, 84 inches	do	.42
Fence posts, wood, 4-inch diameter	do	.26
Poultry netting	Bale	5.02
Barb wire, galvanized, 2-point	Spool, 80 rods	3.40
Gates, galvanized iron, 14 feet	Each	10.60
Feeds and seeds (Nebraska average):		
Laying mash[3]	100 pounds	2.22
Tankage[3]	do	2.86
Hybrid seed corn[4]	Bushels	8.00
Labor (Nebraska average)[5]		
Hired by the month, with board	Month	23.71
Hired by the month, without board	do	33.72
Hired by the day, with board	Day	1.28
Hired by the day, without board	do	1.78

[1] Agricultural Statistics, 1946, pp. 549–50 except as indicated (*55*).
[2] Estimated.
[3] BAE, unpublished data. For 1935 includes only September - December, inclusive.
[4] Estimated. Cost of other seeds assumed to be 20 percent above average farm price (table 28).
[5] Compiled from U. S. Bureau of Agricultural Economics (*52*).

TABLE 30.—*Crop yields, average 1910–41, Cuming County, Nebr., and yields assumed for farm budgets* [1]

Crop	Unit	Cuming County		Yield per planted acre (assumed)
		Yield per harvested acre	Percentage acreage harvested	
Corn	Bushel	32.9	[2]98.4	[4]39
Oats, all	do	30.8	[3]92.4	
Oats, grown alone	do			[5]34
Oats, as nurse	do			[5]23
Barley	do	29.1	[3]94.9	[5]28
Alfalfa hay	Ton	2.7		2.7

[1] Compiled from Nebraska Agricultural Statistics (*35*).
[2] For all purposes.
[3] Does not include some of acreage cut green.
[4] Historical yield increased by 20 percent to allow for influence of hybrid seed.
[5] Pounds of straw produced are assumed to be equal to yield of grain in pounds.

TABLE 31.—*Approximate feed requirements, northeastern Nebraska*

Class of livestock	Feeding period	Production	Feed per animal			
			Corn or corn equivalent	Commercial supplement	Alfalfa hay	Pasture, native
	Days	*Unit*	*Bushels*	*Pounds*	*Tons*	*Acres*
Fattening yearling steer[1]	150	350 pounds	44		0.5	
Fattening 2-year old steer[2]	125	300 pounds	40		.5	
Bull	365		13		2.0	2.0
Beef cow	365	400-pound calf			2.0	2.0
Milk cow	365	160 pounds butterfat[3]	18		2.0	1.5
Calves[4]	365	275-pound gain	8		.7	1.0
Brood sow and one litter[5]	200	1,340-pound pigs,[6] 100 pound on sow	107	385	[7].5 *Acre*	
Boar		150 pounds	10	75		
100-hen flock, including chickens raised[8]	365	1,200 dozen eggs, 750 pounds meat	210	1,275	.3	

[1] Initial weight 675 pounds. Adapted from Nebr. Agr. Expt. Sta. Bul. 274 (*50*).

[2] Initial weight 830 pounds. Adapted from Nebr. Agr. Expt. Sta. Bul. 274 (*50*).

[3] Exclusive of whole milk fed to calf.

[4] Carries calf through first winter and to fall of next year. Adapted from Nebr. Agr. Expt. Sta. Bul. 343 (*49*).

[5] Estimated from unpublished data of the Nebraska Agricultural Experiment Station.

[6] Based on 6 pigs saved, (long-time average) and 5.7 raised (1941–45 average), per litter at 235 pounds (average weight, barrows and gilts marketed at Omaha 1937–41) and sow marketed at 335 pounds average weight.

[7] In addition, one cutting (0.9 ton) of hay will be obtained. Nebr. Agr. Expt. Sta. Cir. 40, (*26, p. 29*) indicates about 20 pigs can be pastured per acre of alfalfa with full-grain feeding.

[8] On basis 250 unsexed chicks bought for replacements and meat, and 20 percent death loss. Cockerels assumed raised to average weight, 3.5 pounds.

TABLE 32.—*Approximate work done in 8-hour day by one man in farm building construction* [1]

Job	Unit	Skilled labor	Farm labor[2]
Set studding, joists, or rafters	Board feet	500	375
Apply sheathing, shiplap, or matched lumber	do	500	375
Apply 6-inch flooring	do	350	262
Apply shingles	Square	2.1	1.6
Apply barn boards	Board feet	1,000	750
Fit and hang doors	Door	7	5
Painting, smooth work	Square yards	80	60
Mix and place concrete for footings (three-man crew)	Cubic yards	4	3
Mix, place, and finish concrete for floors (two-man crew)	Square feet	360	270

[1] Adapted from data supplied by Dept. Agr. Engin., Univ. of Nebr. and from U. S. Dept. Agr., Farmer's Bul. 1772 (*32*).
[2] Assuming 75 percent of accomplishment of skilled labor.

TABLE 33.—*Approximate floor areas for animals with access to outside yards* [1]

Animal	Floor area
	Square feet
Breeding cow, with or without calf	50
Calf: feeder, stocker, or replacement heifer	30
Yearling: feeder, stocker, or replacement heifer	40
Fattening stock, averaging 750 pounds	45
Fattening stock, averaging 950 pounds	50
Bull in pen	120
Cow, in maternity pen	110
Calf, several in pen, each	20

[1] Adapted from S. Dak. Agr. Expt. Sta. Bul. 382, (*47*).

LABOR INPUTS FOR LIVESTOCK ENTERPRISES

Data for labor input, based largely upon farm surveys, are given in several studies of livestock enterprises.

The average labor per year per milk cow reported in a study of the San Joaquin Valley (*45*) was 122 hours for herds averaging 14.2 cows, 102 for herds averaging 26.6 cows, 93 for herds averaging 40.1 cows, and 84 for herds averaging 57.8 cows. A Nevada study (*56*) reported an average chore time for a 10-cow herd of 148 hours per cow. With an increase in size of herd, average hours of labor per cow decreased 1.6 hours for each additional cow.

Studies of the poultry enterprise show similar relationships. In an Oregon study, (*44*) farms with flocks averaging 228 hens reported 4.8 man hours of work per hen; with flocks averaging 450 hens, 3.6 hours were reported; for flocks averaging 718 hens, 3.1 hours; flocks averaging 1,026 hens, 2.8 hours; and the largest flocks, averaging 1,587 hens, reported 2.7 hours.

The relationship between size of cattle herd and production expenses, as reported in an Iowa study, is shown in table 34 (*24*). Feed, labor, equipment, and miscellaneous costs all tended to decline as size of enterprise increased; but farms in the sample represented five distinct types of cattle enterprise, and types were correlated with size of enterprise. Small herds tended to be predominately dairy and dual-purpose types; larger herds often included a number of feeder cattle.

TABLE 34.—*Influence of size of herd on expenses per head of cattle, Iowa County, Iowa, 1925–27* [1]

Size of herd animal units	Farms	Feed	Labor	Interest	Buildings, equipment, and lots	Miscellaneous	Total expense
	Number	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1–9	17	57.38	22.42	4.86	15.06	13.61	113.32
10–19	11	47.85	19.61	5.14	8.01	10.22	90.84
20–29	9	48.31	11.75	5.17	4.94	6.40	76.57
30–39	8	39.40	11.45	4.56	4.17	5.74	65.32
40–49	5	37.02	10.76	5.05	4.06	5.67	62.54

[1] Iowa Agr. Expt. Sta. Bul. 270 (*23, p. 224*).

TABLE 35.—*Relation between number of cattle fed and labor used, full feeding for 80 days, Chase and Lyon Counties, Kans., 1940* [1]

Number of head per farm	Average number head	Farms, number	Man hours per animal for time handled (80 days, average)
1–10	7	3	14.5
11–20	16	9	8.4
21–30	28	6	8.0
31–50	39	13	4.0
51–100	84	10	3.7
101–up	256	8	2.5

[1] Kans. Agr. Expt. Sta., Agr. Econ. Rept. Number 10, (*10, p. 11*).

A Kansas study reports the labor used in fattening cattle on full feed in relation to numbers fed (table 35) (*12*).

According to an Iowa study of the hog enterprise, 5 sows required about 1 hour of labor per day, 15 were cared for in a little less than 2 hours per day, and 25 required about 2.5 hours (*22, p. 187*). But it is noted in the study that a greater proportion of small herds farrowed two litters a year.

An Illinois study covering the years from 1913 to 1922 reported the relationship shown in table 36, between pounds of pork produced annually and labor required (*6*).

A Colorado study shows relationships between size of lamb-feeding enterprise and man-and-horse labor used (table 37) (*5*). These data do not indicate any pronounced tendency for labor requirements to vary with size of enterprise. In this area, lambs are usually hand fed, and are separated into pens of a few hundred lambs each. It is probable that increasing the number of pens would not greatly reduce the work required per head; and, as is pointed out, the larger enterprises required more travel because of the larger area covered by feed lots.

These summaries of available research findings concerning labor and size of enterprise indicate the unsatisfactory nature of much of the available data on labor requirements for livestock if they are to be used in a study of economies of scale.

TABLE 36.—*Relation of size of hog enterprise to labor required, Illinois, 1913–22* [1]

Amount of pork produced annually	Number of records	Man hours per 100 pounds pork produced	Horse hours per 100 pounds pork produced
Under 15,000 pounds	13	3.91	0.659
15,000–25,000 pounds	29	2.50	.614
25,000–35,000 pounds	20	2.57	.501
35,000 pounds and over	20	2.03	.454

[1] Ill. Agr. Expt. Sta. Bul. 301, (*6*).

TABLE 37.—*Relation between number of lambs fed and labor used per day per 1,000 lambs* [1]

Lambs fed, number	Number of farms	Average number head	Hours per day per 1,000 lambs	
			Man	Horse
300–700	7	581	7.42	5.29
701–1,000	12	949	6.62	6.14
1,001–1,500	19	1,330	8.14	6.16
1,501–1,900	11	1,681	7.17	6.65
1,901–2,300	10	2,073	6.13	6.49
2,301–2,800	6	2,507	6.46	6.50
2,801 and over	3	4,419	4.99	6.74

[1] Colo. Agr. Expt. Sta. Bul. 394, (*5, p. 42*).

The Iowa hog study showed that a higher proportion of farmers with a small number of sows produced two litters a year, and in the Iowa study of the cattle enterprise, the nature of the enterprise changed with changes in size of farm.

The Kansas data on cattle feeding are given for the average length of feeding period, 80 days, but they do not indicate whether length of the feeding period was correlated with size of herd. Also, it is shown (*10, p. 10*) that different classes of livestock fed required different amounts of labor, per day and per 100 pounds of gain, but no information is given as to possible correlation between class of livestock fed and size of enterprise. If the reported man-hours per animal are multiplied by the number of animals it will be seen that some of the groups of larger size required less total labor than the smaller ones. This situation probably arises from differences in methods and equipment. Relationships of this kind frequently are found in survey data, adding to the hazards of using unadjusted survey results in budgeting.

The data given in table 36 seem to indicate that although the general tendency was for labor requirements to decrease with increasing size of enterprise, the farms producing between 25,000 and 35,000 pounds of pork required somewhat more man hours per pound of pork produced than was required for smaller or larger herds. The reason for this is not clearly explained in the study.

Livestock labor requirements used in the budgets in this bulletin are adapted from the above sources for all enterprises except hogs. Labor requirements for hogs are based upon data developed from a time and motion study (*43, pp. 549–555*). Assumed labor requirements for major enterprises are given in tables 38 to 40. Table 41 furnishes information on monthly distribution of labor on livestock.

Labor requirements for minor enterprises are taken from various sources and are assumed to be 162 hours a year for each milk cow and 225 hours for 100 hens and replacements.

TABLE 38.—*Estimated annual amount of labor used per head in beef herds, by size of herd* [1]

Size of herd, cows	Hours per cow per year	Size of herd, cows	Hours per cow per year
5	50	19	26
6	48	20	25
7	46	22	24
8	44	24	23
9	42	26	22
10	40	28	21
11	38	30	20
12	36	40	16
13	34	50	15
14	32	60	14
15	30	70	13
16	29	80	12
17	28	90	11
18	27	100	10

[1] Derived from data in Ill. Agr. Expt. Sta. Bul. 329 (*7*), and Kans. Agr. Expt. Sta., Agr. Econ. Rept. 10 (*10*).

TABLE 39.—*Estimated amount of labor used per head for feeder cattle during 150-day feeding period, by size of herd* [1]

Number of head	Hours per head for feeding period[2]	Number of head	Hours per head for feeding period[2]
10	28	30	13
11	26	35	12
12	25	40	11
13	23	45	10
14	22	50	9
15	21	55	9
16	20	60	8
17	19	70	8
18	19	80	7
19	18	90	7
20	17	100	6
21	16	120	6
22	16	140	6
23	15	160	6
24	14	180	6
25	14	200	5

[1] Derived from data in Kans. Agr. Expt. Sta. Agr. Econ. Rept. 10 (*10*).
[2] Includes labor during 150-day feeding period, plus additional labor of acquiring and marketing feeders.

TABLE 40.—*Estimated annual amount of labor used in hog production, by number of sows* [1]

Size of enterprise number of sows	Hours per breeding unit per year	Size of enterprise number of sows	Hours per breeding unit per year
5	39	14	22
6	36	15	22
7	33	20	20
8	30	25	19
9	28	30	18
10	26	35	18
11	25	40	17
12	24	45	17
13	23	50	17

[1] Developed from "time-study data" which have been adjusted upward by 25 percent to allow for farm conditions (*43, pp. 549–565*).

TABLE 41.—*Percentage distribution of man labor required for livestock enterprises, by months* [1]

Months	Hogs	Feeder cattle	Beef herd	Milk cows	Poultry
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
January	5	18	12	11	5
February	3	17	11	10	5
March	5	20	13	11	7
April	18	3	15	9	20
May	14		5	5	15
June	14		3	5	10
July	6		3	5	9
August	6		3	5	9
September	9		3	10	5
October	13	6	8	8	5
November	4	18	12	10	5
December	3	18	12	11	5

[1] Developed on the basis of data in Nebr. Agr. Ext. Service, Planning the farm and home (*36*) and other sources.

ASSUMPTIONS AND DATA USED IN BUDGETS

BUILDINGS AND EQUIPMENT

It is assumed that each farm will have a barn that is adequate to provide space for both storage for hay produced on the farm and shelter for the cattle. With the type of cattle enterprise previously described, barn costs per animal will decrease with increasing size of business, about as shown in table 42. [12] These costs assume that only one dimension is varied. For small buildings, costs might be a little lower if other dimensions were used. The cost of providing feed bunks, corrals, hay racks, and water tanks, would be about $4 a head.

At 1935-39 prices, the cost of materials and labor for constructing an A-type hog house would be about 20 dollars. Cost of fence, waterers, and self-feeders, would be about $7 per sow under the conditions assumed.

The principal equipment assumed to be needed for the poultry enterprise is a combination brooder and laying house. At 1935–39 prices, the cost of constructing a 16- by 50-foot house, adequate for about 200 hens, would be about $800. Construction of roosts, nests, feeders, and a poultry run would be approximately $50. As the dairy enterprise is only for home use, no special buildings or equipment are assumed to be needed. One granary with central driveway is assumed with capacity for 3,500 bushels of corn and 2,000 bushels for small grain. Small-grain space is divided into 4 bins and can also be used for mixed or ground feeds. The cost of constructing such a granary, 27 by 32 feet, would be about $1,300 at 1935–39 prices. For larger farms, additional storage space is assumed to be provided in shed-type cribs.

[12] Building costs for types of farm buildings frequently found in northeastern Nebraska were calculated on the basis of bills of materials specified in farm-building plans distributed by the Nebraska Agricultural Extension Service, and labor requirements shown in table 32. Building space requirements for livestock are shown in table 33.

TABLE 42.—*Approximate cost of building different sizes of cattle barns at 1935–39 prices, northeastern Nebraska*

Size of barn (feet)	Capacity of barn		Construction cost, labor and materials[3]	Cost per square foot of space
	Cattle	Baled hay		
	Head[1]	*Tons*[2]	*Dollars*	*Dollars*
52 by 30	32	26	635	0.41
52 by 40	40	34	760	.37
52 by 50	52	43	890	.34
52 by 60	63	52	1,015	.32
52 by 70	72	60	1,140	.31
52 by 80	80	69	1,265	.30

[1] At 35 square feet per head.
[2] At 210 cubic feet per ton.
[3] Barn is central storage type with gable roof, post and girt construction, dirt floor.

A combination shop and garage, 24 feet by 30 feet, constructed of lumber with a concrete floor would cost approximately $475, at 1935-39 prices.

The average value of farm dwellings as reported by Nebraska keepers of home accounts was $1,659 for the period 1935-39. The average value of dwellings reported in account books from 1929 to 1946 was $1,714. These values are based on cost new minus depreciation. In the budgets, a value of $1,700 is assumed for the dwelling on all sizes of farms.

OPERATOR AND FAMILY LABOR

For the budgets, it is assumed that the operator will spend up to 24 days a month at farm work. For all except the large-scale farm it is assumed that he will put in not to exceed 12 hours a day from April 1 to December 10, and not to exceed 10 hours during the remainder of the year. This provides a maximum of 3,264 hours of labor during the year. Actually, work is not available on the two smaller farms to utilize all his time; he would put in 2,740 hours on the two-plow and 2,713 hours on the three-plow farm. On the large-scale farm it is assumed that half as much time will be available for work in the field because of the increased time required for management. It is assumed that on all farms family labor will be available equivalent to the time of half a man during June, July, and August, and equivalent to 3 hours a day in 24 days of the month during the remainder of the year.

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